NEWFOUNDLAND AND LABRADOR

DEPARTMENT OF ENVIRONMENT

WATER RESOURCES
REPORT 2-5
GROUNDWATER SERIES

HYDROGEOLOGY OF THE HUMBER VALLEY AREA

by

GOLDER ASSOCIATES
ST. JOHN'S, NEWFOUNDLAND
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DEPARTMENT OF ENVIRONMENT
WATER RESOURCES DIVISION
ST. JOHN'S, NEWFOUNDLAND

ABSTRACT

Within the Humber Valley area groundwater is utilized from both the overburden deposits and the underlying bedrock. The yields of groundwater obtained are generally adequate for domestic water requirements.

The highest well yields reported for the study area are obtained from sand and gravel aquifers that occur within the major river valleys. From the available data, wells within these aquifers have an average yield of 100 ℓ/min. However, yields of 900 ℓ/min are locally obtainable.

Groundwater yields from the bedrock underlying the Humber Valley study area vary from low (< 1) to high (455 ℓ/min). The variance in yields shows some correlation with the various rock types encountered. The intrusive granitic and ultramafic rocks plus the high grade metamorphic rocks tend to have low yields within a range of < 1 to 55 ℓ/min with an average yield of 10 ℓ/min. The volcanic and sedimentary rock strata generally have moderate yields that average from 20 to 60 ℓ/min. The limestone and dolostone strata of the St. George's Group are considered to provide bedrock aquifers of the highest yield potential within the study area. Average groundwater yields of 75 ℓ/min are obtainable from drilled wells within this Group.

The groundwater quality from both the overburden and the bedrock is relatively good, and in most cases falls within the criteria established for drinking water purposes. The water is generally fresh and varies from soft to hard. The major dissolved constituents tend to be sodium, calcium, magnesium and bicarbonate. Saline, chloride and sulphate rich groundwaters are locally encountered in the Upper Humber River Valley in those areas underlain by rock strata of the Deer Lake Group. In other areas, elevated concentrations of iron and manganese give rise to some local staining problems in water usage.

It is considered that the potential exists within the Humber Valley area for increased use of groundwater supplies for domestic and limited commercial purposes. In addition, under proper hydrogeological supervision, potential also exists in some areas for the increased use of groundwater for communal water supplies.

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1. INTRODUCTION

1.1 Scope of Study

This hydrogeological investigation of the Humber Valley area of western Newfoundland has been undertaken by Golder Associates for the Water Resources Division, Department of Environment, Province of Newfoundland and Labrador.

The study, in compliance with the guidelines provided by the Department of Environment, provides a hydrogeological evaluation of the bedrock and surficial deposits from existing published and unpublished information. The general trends in potential groundwater yields from the various geological subdivisions within the study area are evaluated. In addition, the investigation provides data on groundwater quality within the area and an overview of the potential for groundwater contamination.

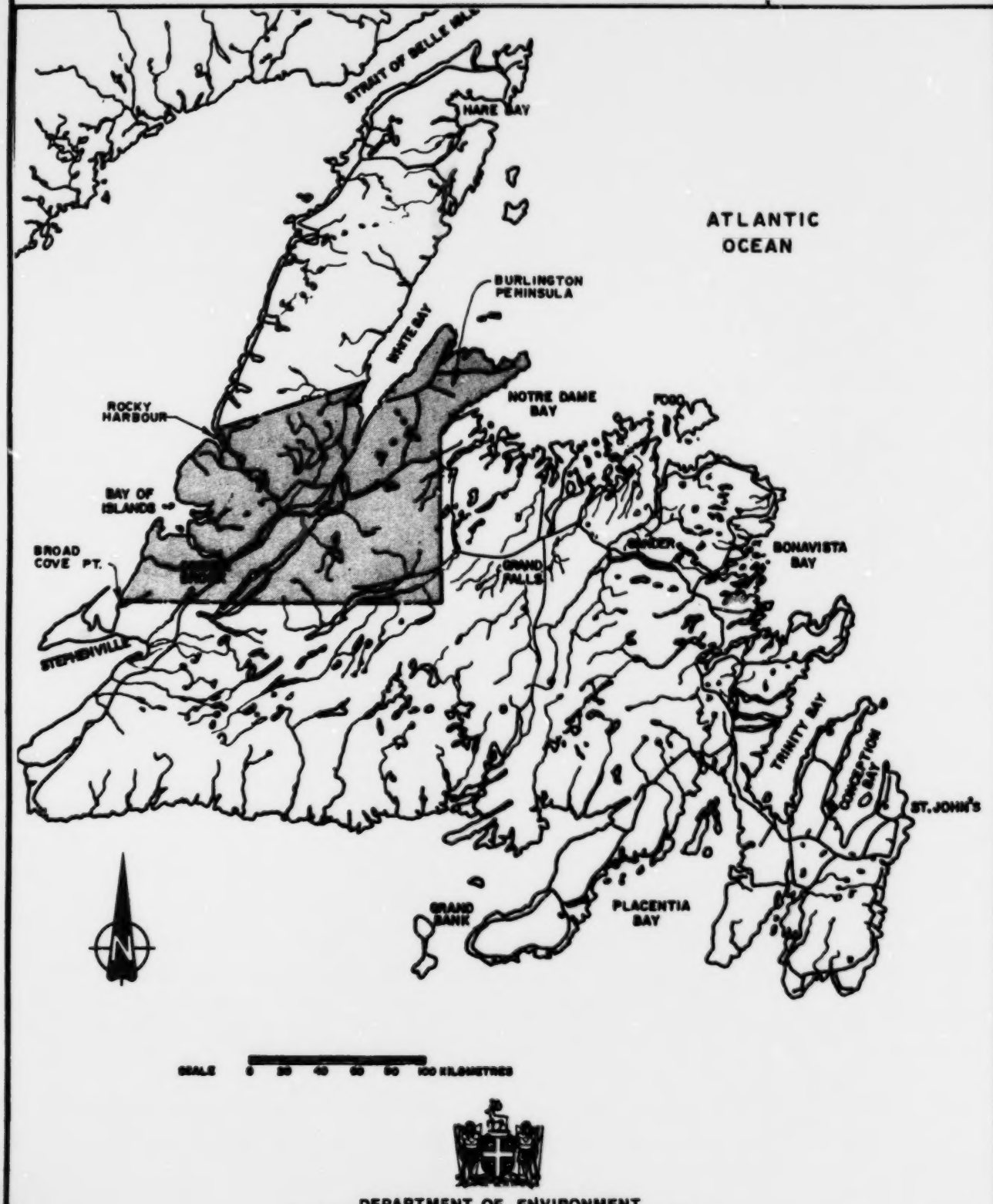
This is the fifth report of a continuing series of groundwater investigations being carried out by the Department of Environment as an inventory of the currently available hydrogeological information to enhance the understanding of the groundwater resources of Newfoundland.

1.2 Location

The Humber Valley study area is located in west central Newfoundland as outlined in Figure 1. The western boundary of the area includes the coastline from Rocky Harbour in the Bonne Bay area south to Broad Cove Point. The southern boundary is formed by 48°45' north latitude from Broad Cove Point eastward to 56°10' west longitude. The eastern boundary is formed by 56°10' west longitude as far north as the community of Kings Point located at the head of South West Arm. The northern boundary of the study area incorporates the Burlington Peninsula from the

LOCATION PLAN
HUMBER VALLEY STUDY AREA NEWFOUNDLAND

FIGURE 1



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community of King's Point to Hampden and the west shore of White Bay from Hampden north to the community of Jackson's Arm. From Jackson's Arm, the boundary runs diagonally westward to Rocky Harbour.

1.3 Previous Work

Previous hydrogeological investigations within the Humber Valley study area have been included in sections of a major study carried out by Shawinigan Engineering Company Limited and James F. MacLaren Ltd. entitled "Water Resources Study of the Province of Newfoundland and Labrador for the Atlantic Development Board. (Shawinigan and MacLaren, 1968).

This report provides a general overview of the groundwater resource in Newfoundland (Volume 2B, Part VIII) and a more specific study of the Humber River Basin (Vol. 6A, Part II).

The areas adjoining the northern and eastern boundaries of the Humber Valley area have been the subject of other studies in this series for the Department of Environment. The areas are discussed in two reports entitled "Hydrogeology of the Great Northern Peninsula" (Nolan, White & Associates Ltd., 1979) and "Hydrogeologic Study of the Notre Dame Bay Area" (Hydrology Consultants Ltd., 1980).

In addition to these reports, which overlap somewhat with the present volume, data is also available from a report entitled "Water Well Data for Newfoundland, 1950-1977" (Consumer Affairs and Environment, 1979). This incorporates a summary of drilled water well data provided by commercial well drillers. Requirements concerning the submittal of such data during the 1950 to 1977 period were not as stringent as at present and subsequently the available information is not complete. More recent well data in the form of open file well records was obtained from the Department of Environment.

Some information pertaining to the study area is also available from the hydrogeological study of Gros Morne National Park situated in the northwest corner of the study area. This work was undertaken for Parks Canada in 1975-76 and is presented in a report entitled "Hydrological Inventory of Gros Morne National Park, Newfoundland, Canada" (O'Sullivan, 1976). In addition to surface water data, this study includes a general description of groundwater conditions within the Park area.

1.4 Acknowledgements

A large portion of the information provided in this report was obtained in the form of unpublished files and individual experience directly from persons in the public service and private industry sectors. Accordingly, appreciation is extended to the following persons for their assistance:

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Mr. R.D. McBridge, Regional Chief

Buchans Mines Ltd., Buchans
Mr. M.G. Neary, Manager

Rambler Mines Ltd., Baie Verte
Mr. J. Grainger, Manager

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Mr. Sam Blagden, Superintendent

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2. DEMOGRAPHY

The Humber Valley Study area has a population of approximately 61,500 located in some 63 incorporated and unincorporated communities. The area includes parts of 6 electoral districts; Baie Verte-White Bay, Bay of Islands, Humber Valley, Humber-St. Barbe, Green Bay and Windsor-Buchans Districts.

Census data for 1966, 1971 and 1976 (Newfoundland Statistics Agency, 1980) is included in Appendix I for those communities within the portions of the 6 electoral districts that fall within the study area. Most districts exhibit some growth in population over this period in the range of 1 to 30 percent. However, the portion of the Windsor-Buchans District population within the study area shows a decline of 24 percent due to a slow-down in both mining and forestry activities in the area. The largest communities in the Humber Valley area are Corner Brook, 25198; Deer Lake, 4546; Baie Verte, 2528 and Buchans, 2078.

The major industrial activity within the Humber Valley area is centred around inshore fishing, forestry and mining. Historically, settlement within the area has been based on fishery requirements. Accordingly, the majority of the communities within this area have been established along the coastline where harbour protection was provided, specifically in the Bay of Islands area, Bonne Bay and numerous inlets along the coast of the Burlington Peninsula.

The Humber River provided a major transportation network into the interior of the area enabling the establishment of a large forestry industry centred at the river mouth in Corner Brook. Settlement followed the forestry industry inland along the Humber River to establish the communities of Pasadena and Deer Lake. Where soil conditions within these areas were suitable such as at Pasadena and Cormack, small scale farming was established to service these local communities. The very

rugged, barren and generally inhospitable nature of much of the interior uplands comprising the Long Range Mountains, Topsail Uplands, and Burlington Peninsula has largely restricted the establishment of population centres to the coastline and Humber River Valley.

Mining activity has played a significant role in the development of communities within the Humber Valley region. Small copper sulphide deposits have been worked adjacent to communities such as Tilt Cove along the Burlington Peninsula. In the Baie Verte area, the asbestos mining activity of Baie Verte Mines Ltd. (formerly Advocate Mines) has greatly augmented the industrial activity of this fishing community since mining operations began in 1963. In addition, the copper sulphide mining operations of Rambler Mines has benefitted the community since 1964.

Large scale mining activity has also been carried out in the Buchans area. Although started in 1928, mining activity in this area is currently depressed due to declining reserves and metal prices. However, the potential exists for future expansion in mining in this region.

3. PHYSIOGRAPHY

The Humber Valley study area is largely situated within the physiographic region referred to as the Newfoundland Highlands (Bostock, 1970). This broad region comprising the Long Range Mountains and associated valleys is further subdivided into four sub-regions, the Great Northern Highlands, Blow Me Down Highlands, Atlantic Upland of Newfoundland and the Grand Lake Lowlands (Sanford et al, 1976) as shown on Figure 2.

The Great Northern Highlands form a barren, mountainous plateau largely composed of crystalline rock that extends northward along the Great Northern Peninsula from Bonne Bay and the Lomond River Valley. Elevations within this area vary from about 180 to 800 m. The western margins of this highland rise as a steep escarpment from the West Newfoundland Coastal Lowlands. This escarpment is locally incised by glacially carved fiords. Inland, the surface of the highlands slope gently south-eastward towards White Bay and the Humber River Valley. The major drainage courses formed by the Upper Humber River and the Main River also tend to follow this slope, flowing south-eastward.

The Blow Me Down Highlands form an area of dissected plateaus and mountains that rise abruptly from the Gulf of St. Lawrence in the Bay of Islands - Trout River areas to elevations in the order of 550 to 700 m. Steep sided fiord inlets and valleys extend into the highlands from the west coast notably in the Bay of Islands area (see Figure 2). Drainage from the highlands also flows westward to the Gulf of St. Lawrence via numerous small brooks.

The mountains of the Blow Me Down Highlands are a sparsely forested area largely comprised of folded sedimentary rocks. However, much of the plateau areas adjacent to the coast are comprised of ultramafic rocks that form a conspicuous barren, brown coloured landscape.

PHYSIOGRAPHIC REGIONS
HUMBER VALLEY AREA, NEWFOUNDLAND

FIGURE 2

DEPARTMENT OF ENVIRONMENT
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SCALE 1: 1,000,000
REFERENCE: SANFORD ET AL, 1976
ATLANTIC OCEAN
GULF OF ST. LAWRENCE
BURLINGTON PENINSULA
CENTRAL LOWLANDS
NEWFOUNDLAND
ATLANTIC UPLAND OF NEWFOUNDLAND
(TOPSAIL UPLANDS)
GREAT NORTHERN HIGHLANDS
(LONG RANGE MOUNTAINS)
GREAT NORTHERN PENINSULA
GRAND LAKE LOWLANDS
WEST NEWFOUNDLAND COASTAL LOWLANDS
BLOW ME DOWN HIGHLANDS
(LONG RANGE MOUNTAINS)
BONNE BAY
BAY OF ISLANDS
Fleur de Lys
La Scie
Wild Cove
Seal Cove
Bois Verte
Goose Arm
Deer Lake
Corner Brook
Summerside
Woody Point
Norris Point
Trout River
Rocky Harbour
Cow Head
St. Pauls
Portland Creek
Port au Port
Lark Harbour
Woods Island
Birchy Head
Chimney Cove
Baker's Brook
Sally's Cove
Pillars Is.
Cull Island
Triton
Port Anson
Badger
Millertown
Buchans
Grand Falls
Botwood
Gallants
Aspen Brook
Pasadena
South Brook
Stephenville
Stephenville Crossing
Kippens
Flat Bay
Black Duck Brook
Jackson's Arm
Western Arm
Bear Cove
Portaberry
Cooks Cove
Hampden
Sandy L.
Red Indian L.
Kitty's Brook
Howley
Quarry
Rocky Salt
Deadman's Bay
Lomond
Birchy Head
Woody Point
Trout River
Rocky Harbour
Norris Point
Lomond
Deer Lake
Corner Brook
Summerside
Woody Island
Lark Harbour
Aspen Brook
Gallants
Badger
Millertown
Buchans
Grand Falls
Botwood

The Atlantic Upland of Newfoundland forms a barren to sparsely forested, granitic plateau between Grand Lake and Red Indian Lake extending northward into the Burlington Peninsula (see Figure 2). This terrain comprises the barren lands of the Topsail Uplands which rise to elevations of about 400 to 600 m. These uplands are more subdued than the coastal mountains to the west. Nevertheless, they form the drainage divide between the Humber River Valley and the Exploits River Valley to the east.

The Grand Lake Lowlands are located centrally within the study area where they comprise a large northeast-southwest trending intermontane valley as shown on Figure 2. The lowlands include the large water bodies of Grand Lake, Sandy Lake and Deer Lake all of which drain south-westward via the Humber River. The central area of the lowland located along the Upper Humber River comprises the Deer Lake Basin which forms a conspicuously flat valley floor some 50 km in length and 15 km in width. This area varies in elevation from 30 to 90 m and is variously covered by forest and bogs.

The Newfoundland Central Lowlands of the Notre Dame Bay area east of the Atlantic Upland extend south-westward into the study area along the Exploits River Valley to the Buchans-Red Indian Lake area including the eastern half of the Burlington Peninsula (see Figure 2). These lowlands gently rise to elevations of 300 m in the west and are largely covered by forests and bogs. The Exploits River, South Brook and Indian Brook are the major drainage courses all of which flow north-eastward towards Notre Dame Bay.

4. CLIMATE

The Humber Valley area has a temperate, maritime climate influenced by the Gulf of St. Lawrence and the effects of the Long Range Mountains. Climatic conditions within and immediately adjacent to the study area have been monitored at 10 weather stations for portions of the period from 1951 to 1980 (Environment Canada, 1981). The total annual precipitation and annual daily average temperature for these stations are listed on Table 1. The average monthly temperature and precipitation for 6 of the stations comprising Badger, Baie Verte, Buchans, Corner Brook, Deer Lake Airport and Rocky Harbour are represented in histogram form on Figures 3 and 4.

The annual average daily temperature within the study area varies within a range from 2.9^{o}C at Baie Verte to 5.1^{o}C at Corner Brook (see Table 1). The mean monthly temperature is below freezing for the period of December through March as shown on Figure 3. The warmest periods occur during July and August when average daily temperatures range from 15 to 17^{o}C.

The range of total annual precipitation within the study area varies from 943.5 to 1470.0 mm as determined from the available weather stations (see Table 1). The greatest amount of precipitation in the order of 1100 to 1500 mm occurs along the west cost and upland areas of the Long Range Mountains and the Topsails due to orographic effects. The amount of precipitation diminishes eastward to within a range of 943 to 967 mm at Badger and Springdale, respectively. The lowest periods of monthly precipitation occur during the spring and early summer (see Figure 4).

TABLE 1

ANNUAL PRECIPITATION AND AVERAGE DAILY TEMPERATURE

COMMUNITIES IN HUMBER VALLEY AREA

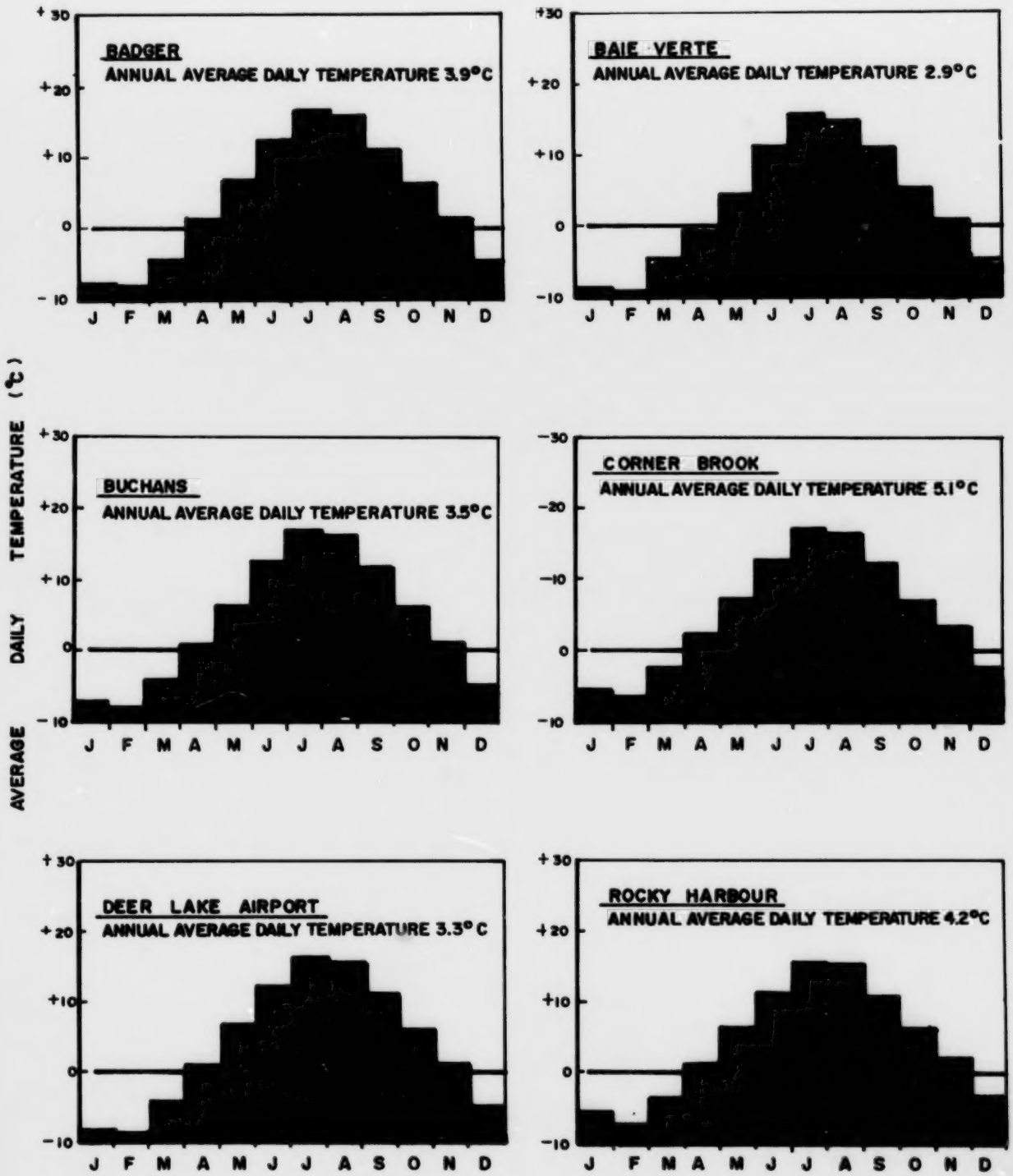
NEWFOUNDLAND

COMMUNITY	ANNUAL PRECIPITATION (mm)	AVERAGE DAILY TEMPERATURE (^{o}C)
Badger	943.5	3.9
Baie Verte	1064.7	2.9
Buchans	1071.5	3.5
Corner Brook	1133.5	5.1
Deer Lake	1033.1	4.1
Deer Lake Airport	1023.2	3.3
Exploits Dam	1099.0	3.2
Rocky Harbour	1199.7	4.2
Springdale	967.1	3.9
Woody Point	1470.0	4.6

Data obtained from Environment Canada Climatic Normals for 1951-1980, Atlantic Provinces, (Environment Canada, 1981)

AVERAGE DAILY TEMPERATURE PER MONTH FOR PERIOD 1951 TO 1980 FROM ENVIRONMENT CANADA WEATHER STATIONS HUMBER VALLEY AREA, NEWFOUNDLAND

FIGURE 3



DATA FROM ENVIRONMENT CANADA, 1981

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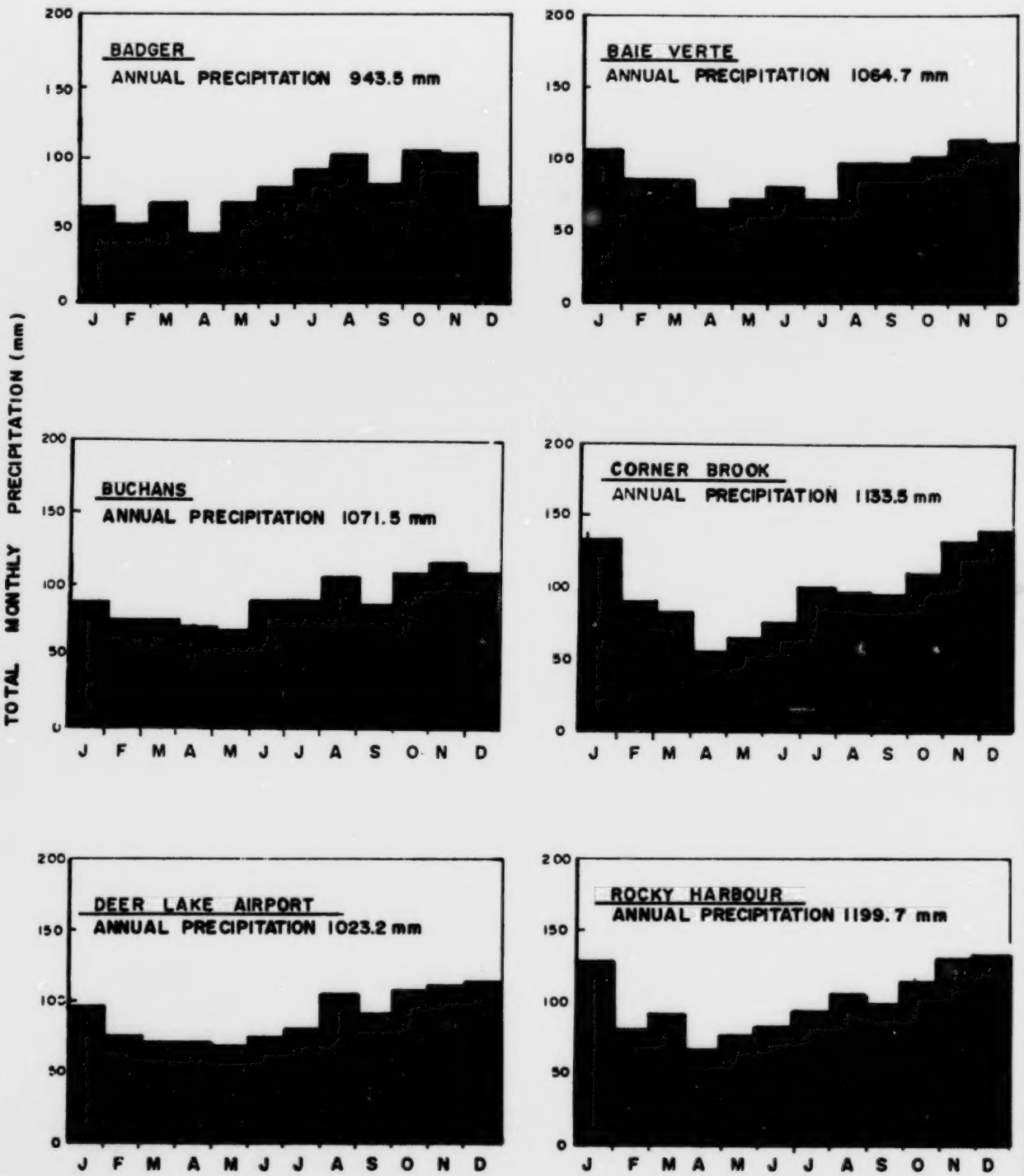
TOTAL MONTHLY PRECIPITATION FOR PERIOD 1951 TO 1980 FROM ENVIRONMENT CANADA WEATHER STATIONS HUMBER VALLEY AREA, NEWFOUNDLAND

FIGURE 4



DATA FROM ENVIRONMENT CANADA, 1981

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5. GEOLOGY

5.1 Surficial Geology

The surficial geology of the Humber Valley study area has been compiled at a scale of 1:250,000 on Map 1 accompanying this report. The map represents a summary of the surficial mapping that has been carried out within this area by both the Geological Survey of Canada and the Newfoundland Department of Mines and Energy.

The government mapping was carried out largely by air-photo interpretation at a scale of 1:50,000 with limited ground traversing. Government mapping within the area is ongoing and to date has concentrated on the coastal areas and interior valleys where transportation corridors exist. Accordingly, much of the uninhabited upland areas of the Topsail Uplands and White Bay areas as yet remain largely unmapped. The extent of currently available government mapping is outlined on Map 1.

For the purpose of this study, the surficial geological units represented on the government mapping have been simplified into four subdivisions. These subdivisions include areas of exposed bedrock, areas of glacial till, areas of sands and gravels and areas of peat deposits.

5.1.1 Exposed Bedrock

Areas of exposed bedrock form extensive rock plains, knobs and ridges throughout much of the study area. The rock may be partially or fully concealed in places by a mat of vegetation including either sparse forest, scrub or peat bog. A thin soil veneer generally comprised of till occasionally occurs adjacent to rock outcrops.

Much of the area of the highlands of the Long Range Mountains are comprised largely of exposed bedrock with rock talus or colluvium occurring on the mountain slopes. Similarly, large areas of exposed bedrock occur in the Topsail Uplands and Burlington Peninsula.

5.1.2 Glacial Till Deposits

Glacial till deposits are found throughout the study area as both thin surficial veneers and as more extensive moraine deposits. The composition of the tills closely reflects the lithology of the underlying bedrock. Consequently, the tills within the Long Range Mountains, Topsail Uplands, Exploits River Valley and Burlington Peninsula are comprised of grey silty sand or sandy silt derived from the underlying predominantly granitic and metamorphic terrain. In contrast, tills within the Humber River Valley are comprised of red clayey silt derived from the underlying red siltstones of the Carboniferous strata.

The various areas of till cover indicated on Map 1 also include local unsubdivided deposits of ice contact sand and gravel.

The most extensive developments of glacial till within the study area occur within the Upper Humber River Valley north of Deer Lake and within the Exploits River Valley in the vicinity of Red Indian Lake and Buchans.

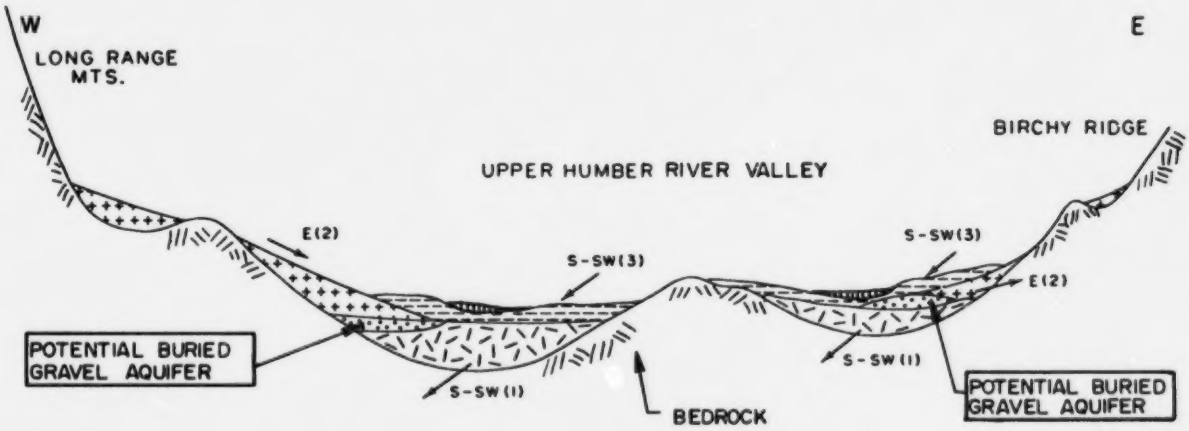
5.1.2.1 Upper Humber River Valley

The basin forming the Upper Humber River Valley contains a complex, interstratified sequence of glacial tills, outwash and fluvial deposits. A generalized profile of the stratigraphy within the Upper Humber River Valley from Birchy Ridge to the Long Range Mountains is shown on Figure 5.

The basal till unit which forms the lowest member of the surficial sequence is comprised of compact clayey-silt plus pebbles and cobbles derived from the underlying Carboniferous mudstone and siltstone strata. Current indications are that this till was transported to the southwest parallel to the Humber Valley (Vanderveer and Sparkes 1982) where it has locally accumulated to depths in excess of 120 m in the lower reaches of the Valley near Steady Brook (Gale, 1983).

SCHEMATIC REPRESENTATION OF SURFICIAL DEPOSIT STRATIGRAPHY, UPPER HUMBER RIVER VALLEY HUMBER VALLEY AREA, NEWFOUNDLAND

FIGURE 5



LEGEND

- Postglacial sand and gravel
- Late Wisconsin till of local provenance [*Transported to south-southwest*]
- Grey till of Long Range Mountains provenance [*Transported to east-southeast*]
- Interglacial/interstadial sand and gravel
- Red clay till [*Transported to south-southwest*]
- E(2) Glacial flow direction and relative age [*S-SW indicates transported to south-southwest (1) indicates oldest*]

REFERENCE

FIGURE TAKEN FROM D.G. VANDERVEER AND B.G. SPARKES, 1982.

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A pinkish grey silt till overlies the basal till. It is considered that this material was deposited from ice that advanced from the Long Range Mountains towards the northwest.

The final till sheet which overlies much of the valley and is responsible for the majority of the surface landforms in this area is considered to have been deposited by a southwesterly ice advance. This upper till is of local provinance. It is quite variable in composition, the clast and matrix composition closely reflecting that of the most proximal bedrock. It is less compact than the older underlying tills.

As schematically shown on Figure 5, outwash sand and gravel deposits locally occur interstratified between the till sheets. These are most notable in the Birchy Lake and Adies Pond areas.

5.1.2.2 Exploits River Valley

A complex surficial stratigraphy has also been identified in the Buchans-Red Indian Lake area (Vanderveer and Sparkes, 1982). A grey, compact basal till, derived from an ice centre possibly located in the Topsail Uplands northwest of Red Indian Lake, was initially deposited over much of this area. Subsequent retreat of this ice sheet resulted in pro-glacial damming of Red Indian Lake and the deposition of glaciofluvial and glaciolacustrine sediments over the top of the basal till. Following this period, a second ice advance from the northwest covered these sediments with a thin mantle of till.

The identification of interstratified glacial deposits within the Upper Humber River Valley and Red Indian Lake areas suggest that similar relationships may exist elsewhere within the study area where thick surficial deposits occur.

5.1.3 Outwash and Fluvial Sand and Gravel Deposits

Within the study area, sand and gravel deposits of glacial outwash and fluvial origin are generally confined to stream and river valleys as shown on Map 1. Although not extensive, these deposits are fairly widespread and in many instances occur in the vicinity of established communities.

The sand and gravel units represented on Map 1 also include unsubdivided lacustrine and marine terraces that contain various silt and clay deposits in addition to sands and gravels.

Major areas of sand and gravel deposits are located in the Deer Lake and Upper Humber River Valley plus the Sandy Lake and Birchy Lake areas. These deposits, as shown on Map 1, include only those that are exposed at surface. As previously discussed, additional buried deposits of sand and gravel occur at various points interstratified within the till deposits (see Figure 5). Similar situations occur in the Buchans-Red Indian Lake area.

Another major area of sand and gravel is exposed within the Indian Brook Valley extending northeast from Birchy Lake to Southwest Arm and Halls Bay.

5.1.4 Peat Deposits

Peat deposits are quite common throughout the study area (see Map 1). These deposits occur extensively on the barren Topsail Uplands between Grand Lake and Indian Lake. Peat deposits occur to a lesser extent on the highland plateau areas of the Long Range Mountains and Burlington Peninsula. Within these areas, the peat has accumulated in the form of high moor bogs and string bogs. The peat can attain thicknesses of the order of several metres overlying either till and fluvial deposits or bedrock.

Peat bogs are also common in the flat terrain of the Upper Humber River Valley north of Deer Lake. In this area, they overlie till or sand and gravel deposits.

5.2 Bedrock Geology

The bedrock geology of the Humber Valley area includes sedimentary, volcanic and granitic rock strata varying in age from Late Precambrian to Late Paleozoic. These strata have undergone various periods of complex deformation which has resulted in major folding and extensive faulting. These structural features generally follow southwest-northeast trends which reflect the similarly aligned nature of the existing mountains and valleys within the region.

The tectonic development of this region of Newfoundland is widely accepted as having developed in response to ancient continental drift processes stemming from the Early to Late Paleozoic Era (Williams, 1979). Accordingly, the rock strata within the area represents a broad range of diverse assemblages.

These assemblages include extensive areas of continental platform, shelf and margin strata plus ophiolite complexes (both in place and structurally transported), island arc and subaerial volcanic complexes, and granite batholith complexes. The assemblages also include late to post deformational strata deposited in intermontane valleys.

For the purposes of this study, the geology is discussed mainly in terms of type and distribution of the various rock strata with limited discussion of petrogenesis and structural interpretation. The bedrock geology of the Humber Valley study area is shown on Map 2 accompanying this report.

5.2.1 Continental Platform Rocks

Strata within this subdivision comprise Late Precambrian granitic and metasedimentary gneiss, plus anorthositic and gabbroic intrusions of the Long Range Complex. This complex, representing the oldest rock

strata within the area, formed the continental platform or shelf from which much of the adjacent younger sedimentary rocks were derived.

Due to the resistant granitic nature of the Long Range Complex, it still forms much of the highland area of the Long Range Mountains within the northwestern portion of the study area (see Map 2). The headwaters of the Upper Humber River are located within this semi-mountainous terrain.

5.2.2 Continental Margin and Rift Facies Sediments

Sedimentary rocks within this classification have developed from deposition within a continental shelf and continental rise environment. Within western Newfoundland, four broad stratigraphic groups can be recognized; the Fleur de Lys SuperGroup, the Labrador Group, the Humber Arm Group and the St. George's Group.

The Fleur de Lys SuperGroup are the oldest sedimentary strata within the area. They comprise Late Precambrian to Cambrian age pelitic and psammitic schists plus minor marble. The structural trend of this assembly is northeast-southwest. These deformed, high grade metamorphic rocks underlie much of the western half of the Burlington Peninsula. Rocks of similar age, composition and metamorphic grade also form much of the highlands between Grand Lake and the Lower Humber River. The Fleur de Lys rocks possibly represent an eastward facing, clastic wedge that developed on the Late Precambrian continental margin of western Newfoundland.

The Labrador Group is comprised of slate, phyllite, quartzite, sandstone and thin bedded carbonates of Cambrian age. This assemblage forms a narrow belt of southward dipping moderately metamorphosed strata that trends northwest-southeast from Gros Morne Mountain near Rocky Harbour toward the Deer Lake area. This group unconformably overlies the gneissic rocks of the Long Range Complex and is considered to represent strata deposited within a continental shelf environment.

The Humber Arm Group is a Cambrian age sequence comprised largely of shale, phyllite and greywacke that also includes lesser amounts of quartzite, sandstone and carbonates. This group underlies the western half of the Blow Me Down Uplands extending from Rocky Harbour in the north to the Bay of Islands-Corner Brook area in the south. The group is a klippen that was emplaced by westward thrust faulting during the Ordovician. The structure within this group is consequently quite complex as noted by steeply dipping strata and faulting.

The St. George's Group is dominantly comprised of Early Ordovician limestone and dolostone. This continental shelf facies carbonate sequence forms much of the Long Range Mountains west of Deer Lake. It extends from the Rocky Harbour area southward through the Lomond River Valley and Old Mans Pond area and forms the hills east of Corner Brook. The group has been deformed by folding and faulting, part of which occurred during the emplacement of the Humber Arm Group klippen by westward thrusting over the top of the St. George's Group rocks.

Weathering of the limestone-dolostone strata of the St. George's Group has produced a rugged terrain with steeply incised valleys. Karsting has been significant within this group as noted by various small lakes and ponds with internal drainage and the occurrence of disappearing stream courses.

5.2.3 Ophiolite Igneous Complexes

The ophiolite complexes of western Newfoundland represent slabs of ancient Cambrian age ocean crust composed of a basal ultramafic sequence of periodotites, dunites and pyroxenites overlain by a mafic sequence of gabbro and diabase. Pillow basalts form the top layer of the ophiolite and represent ocean floor volcanics. The ultramafic rocks within these complexes tend to be serpentinized and asbestos mineralization is locally common.

The Bay of Islands ophiolite complex forms the large barren mountains located along the west coast from Table Mountain at Bonne Bay, south to Blow Me Down Mountain and the Lewis Hills in the southwest corner of the study area (see Map 2). The complexes form three individual fault bounded plateau areas separated by sedimentary rocks of the Humber Arm Group.

The Bay of Islands ophiolite is a klippen that was structurally emplaced onto the ancient continental platform by westward thrust faulting that probably occurred contemporaneously with the thrust emplacement of the underlying Humber Arm Group.

The Baie Verte and Betts Cove ophiolitic complexes occur in a narrow belt some 1 to 3 km in width. This belt extends north-westward through the central Burlington Peninsula adjacent to the Baie Verte highway and along the eastern coastline in the Nippers Harbour-Tilt Cove vicinity (see Map 2). The rocks within these complexes have undergone a higher degree of structural deformation and serpentinization than those of the Bay of Islands Complex. Asbestos mineralization associated with serpentinization of the ultramafics is also more common than in the Bay of Island rocks, accordingly, asbestos is locally mined in the Baie Verte area. Sulphide mineralization also occurs at several locations notably within the volcanics of the uppermost ophiolite layer.

5.2.4 Island Arc and Subaerial Volcanic Complexes

Volcanic rocks formed in an island arc environment occur along the eastern half of the study area from Red Indian Lake to the Burlington Peninsula. The volcanics and associated sedimentary strata of the Island Arc complexes were deposited from the Early Ordovician to the Silurian. Subaerial volcanics were subsequently deposited over the top of the Island Arc sequences during the Silurian to Devonian.

The rock within these sequences includes both intermediate and felsic composition volcanic flows and pyroclastics plus associated shales, greywackes, sandstones and conglomerates. The strata have been variously deformed during periods of low grade metamorphism. The rocks within this category have been subdivided into several groups and ages as shown on Map 2. The copper-lead-zinc sulphide deposits of Buchans, Rambler and Gull Bridge mines occur within these Late Ordovician to Silurian age volcanic sequences.

5.2.5 Granitic Complexes

Granitic batholiths ranging in age from Ordovician to Devonian underlie much of the eastern half of the study area. The batholiths are largely comprised of granodiorite and quartz monzonite. Due to their massive nature, these rocks tend to form resistant upland areas. The largest granite complex is the Topsail Granite which forms the Topsail Uplands between Grand Lake and Red Indian Lake. A large proportion of the Burlington Peninsula is also underlain by granitic complexes including the Burlington Granodiorite, Cape Brule Porphyry, and the Wild Love Pond-Gull Lake complexes.

5.2.6 Intermontane Trough Sediments

The culmination of mountain building in Western Newfoundland during the Devonian Period and subsequent erosion resulted in the deposition of sedimentary strata within the Deer Lake Basin during the Carboniferous Period. This basin underlies Deer Lake, Grand Lake, Sandy Lake and the Upper Humber River Valley. The basin developed as a northeast-southwest trending valley between the Long Range and Topsail Mountains.

The carboniferous rock strata within the Deer Lake Basin shown on Map 2 have been gently folded and locally faulted. They have been stratigraphically subdivided into two groups: the Lower Anguille Group and the unconformably overlying Deer Lake Group (Hyde, 1979). The

Anguille Group is comprised of well cemented, grey coloured conglomerate, sandstone, siltstone and mudstone. The overlying Deer Lake Group is comprised of poorly indurated, red and grey coloured conglomerate, sandstone, siltstone, mudstone, oil shale and minor coal beds.

6. HYDROGEOLOGY

6.1 Hydrostratigraphic Units

For the purpose of assessing the groundwater yield potential of the various lithologies present in the Humber Valley area the surficial and bedrock geology within the study area has been subdivided into nine hydrostratigraphic units.

The hydrostratigraphic units have been developed by grouping surficial deposits and bedrock types into broad units of similar lithologic character and hence potential water bearing nature. These lithologic groupings were then compared with the reported well yields and depths from the available records of wells completed within each unit.

The hydrogeological data base provided from the available water well records within the Humber Valley area is limited. A total of 160 individual records of drilled wells were obtained for the study area from published and unpublished Department of Environment water well records. Of these, 158 records reported well depth while only 116 reported well yield.

The well yield characteristics were generally determined by either bailing or air blowing for a period of time considered sufficient by the driller for the users' requirements. As such, the reported yields do not represent precise pump test well yield characteristics for the various strata encountered.

The available water well records for the Humber Valley study area are summarized in table form in Appendix II of this report. In addition to well depth and yield, the records provide some information concerning well casing depth and diameter, depths at which water was found plus data on the quality and use of the water and a drillers' description of depth and lithology of the overburden and bedrock types encountered. It should be noted, however, that individual well data is seldom complete.

The location of communities within the Humber Valley area for which water well records exist plus the number of wells in that community is shown on Map No. 3.

6.1.1 Surficial Hydrostratigraphic Units

The surficial deposits within the Humber Valley area have been subdivided into two broad hydrostratigraphic units, one comprised essentially of till deposits and the other predominantly of sands and gravels. The yield and depth characteristics of these units are summarized on Table 2 and shown on Map 1.

6.1.1.1 Unit A - Till Deposits

The till deposits form a thin veneer over much of the study area within stream valleys and on the flanks of bedrock hills. The composition of the matrix of the tills varies from silty sand to clayey silt, generally representing materials of moderate to low permeability.

No records of drilled wells were identified within this unit,however it is utilized for shallow dugout domestic wells. The yields from these wells are generally low and much of the water utilized is derived from storage within the well itself. Based on data from the Notre Dame Bay area (Hydrology Consultants Limited, 1980) the range of yield from wells within the till can be expected to vary from 0 to 45 ℓ/min. depending on the material encountered. The average yield is considered to be in the order of 9 ℓ/min. or less (see Table 2).

6.1.1.2 Unit B - Sand & Gravel Deposits

Deposits of sand and gravel provide the greatest yield potential for wells within the Humber Valley area. Deposits of this nature occur extensively within the Deer Lake - Upper Humber River Valley and the Birchy Lake - Indian Brook Valley. Elsewhere within the study area similar deposits are widely distributed, however, they are generally restricted in extent to narrow stream valleys.

Seven well records were located for the Humber Valley area for drilled wells completed within sand and gravel. A wide range of yield from 4 to 340 ℓ/min was obtained at depths of 10 to 15 m. The mean yield was 100 ℓ/min and the median was 45 ℓ/min at 14 m depth. This data suggests that a yield of 45 ℓ/min can be anticipated from a properly completed well in the sand and gravel deposits (see Table 2).

The communities of Gillams and Cox's Cove in the Bay of Islands area utilize communal wells drilled in sand and gravel for their water supplies. At Gillams, a 152 mm cased well with a 1.2 m length screen at the bottom was completed to a depth of 12 m in gravel. Following well development and an engineered pump test, the long term safe yield for the well was assessed at 340 ℓ/min. (Dominie, 1983).

A drilled well was constructed in surficial materials at the Deer Lake Airport in November of 1977 for the purpose of providing an adequate water supply for domestic and fire fighting requirements. A detailed report on the construction and pump testing of this well is provided in a report prepared by Environment Canada (Environment Canada, 1980).

The 152 mm diameter, cased pumping well, encountered very fine grained silty sand, clayey silts and silty clays to a depth of 50.3 m. Beneath this material, a major water bearing bed of silty, gravelly sand and sandy gravel was encountered from 50.3 to 54.9 m directly overlying bedrock.

During September 1978, a 1.5 m well screen was installed within this water bearing horizon between 52.7 and 54.2 m. The screen size was designed following a grain size evaluation of the aquifer materials collected during drilling. The screen slot size selected was 2.54 mm (#100 slot) which is capable of transmitting 318 ℓ/min (70 gpm).

Also in September 1978, a 152 mm diameter, cased observation well was drilled to a depth of 60.9 m in silty and clayey sand and sandy to silty clays at a location some 168 m south of the pumping well. The observation well did not encounter the same gravel bed that was screened within the pumping well.

TABLE 2

SURFICIAL DEPOSIT HYDROSTRATIGRAPHIC UNITS

HUMBER VALLEY AREA, NEWFOUNDLAND

SURFICIAL HYDROSTRATIGRAPHIC UNITS	WELL YIELD lpm (gpm)			WELL DEPTH m (ft.)			DATA SOURCE
	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	
UNIT A TILL LOW YIELD	0-45 (0-10)	9 (2)		5-46 (15-150)			1
UNIT B SAND AND GRAVEL	4-340 (1-70)	100 (22)	45 (10)	10-15 (32-50)	13.1 (43)	14 (45)	2
MODERATE TO HIGH YIELD	55-270 (12-60)	25 (5.4)	23 (5)	8-27 (25-90)	14 (46)		1

SOURCES OF INFORMATION:

1. Hydrogeological study Notre Dame Bay Area, Nfld. Water Resources Report 2-1, Dept. of Consumer Affairs and Environment, Province of Newfoundland and Labrador.

2. Hydrogeological Study Humber Valley Area.

Following a 3 stage step drawdown test, a 72 hour pump test was undertaken. A submersible pump was set at 47.5 m and the test was carried out at a pumping rate of 545 ℓ/min (120 gpm), which was the maximum capacity of the pump. At the end of the pump test, 4.0 m of drawdown was measured in the pumping well whereas 0.05 m was recorded in the observation well. From the limited drawdowns obtained, it was considered that the pumping test did not adequately stress the aquifer to properly define the hydraulic characteristics.

Due to the negligible drawdown obtained from the observation well, the pump test was evaluated using the modified non-equilibrium Jacob method for the drawdown and recovery observed in the pumping well. The results of this pump test analysis indicated that the transmissibility of the gravel aquifer varies from 1.4×10^2 to 3.9×10^2 m^3/day/m. These transmissibility values indicate that a 20 year safe yield estimate for the gravel aquifer, assuming 6.1 m of permissible drawdown, is within the range of 330 to 894 ℓ/min (73 to 197 gpm). These predicted well yields provide an indication of the high yield capacities that are potentially available from the surficial sand and gravel aquifers.

The deposits of sand and gravel generally constitute surficial aquifers. However, within the Upper Humber River Valley and the Exploits River Valley, fluvial deposits of sands and gravel occur interstratified with tills as discussed in Section 5.1.2. Under these circumstances, the buried sand and gravel deposits, as schematically depicted on Figure 5, will tend to behave as confined or semi-confined aquifers similar to the gravel aquifers encountered in the Deer Lake Airport well. These buried deposits are not indicated on the surficial geology map (Map No. 1) nor is their location or extent fully understood. However, they may offer potential groundwater exploration targets in the Reidville-Cormack areas of the Humber River Valley and the Buchans-Millertown areas of the Exploits River Valley.

6.1.2 Bedrock Hydrostratigraphic Units

The bedrock underlying the study area has been subdivided into seven hydrostratigraphic units based on rock type and well yield. These units are summarized on Table 3 and shown on Map 3.

The available well record information within the Humber Valley area is limited to rock strata of the Fleur de Lys, Humber Arm, St. George's Anguille and Deer Lake sedimentary rock groups, plus the volcanic rock groups and rocks of the ophiolite complexes. The well yield and depth characteristics for these various strata are summarized in histogram form on Figures 6 and 7.

Unfortunately, no water well information was available for the areas of granitic and gneissic bedrock complexes which underlie approximately 40 percent of the study area. Accordingly, for the purposes of this study, because of the expected similarity of conditions in the granitic rocks throughout this part of Newfoundland, well characteristics within these areas were deduced from the adjacent Notre Dame Bay study area (Hydrology Consultants Limited, 1980).

Based on the available data, it is considered that the occurrence of groundwater within the bedrock hydrostratigraphic units is almost entirely controlled by features of secondary permeability. Primary permeability within the sedimentary and volcanic strata related to intergranular porosity has largely been eliminated by the effects of deep burial and metamorphism. The secondary permeability features include open jointing and bedding planes within the rock plus fractured zones related to faulting. Accordingly, it is these features that provide groundwater to drilled wells within the bedrock.

The major linear fault structures that traverse the study area in a southwest to northeast direction (see Map 2) may be associated with zones of extensive fracturing up to a hundred metres in width with potentially high water yield. These features are not included within the hydrostratigraphic unit subdivisions but should be regarded as areas of potentially good groundwater sources.

TABLE 3

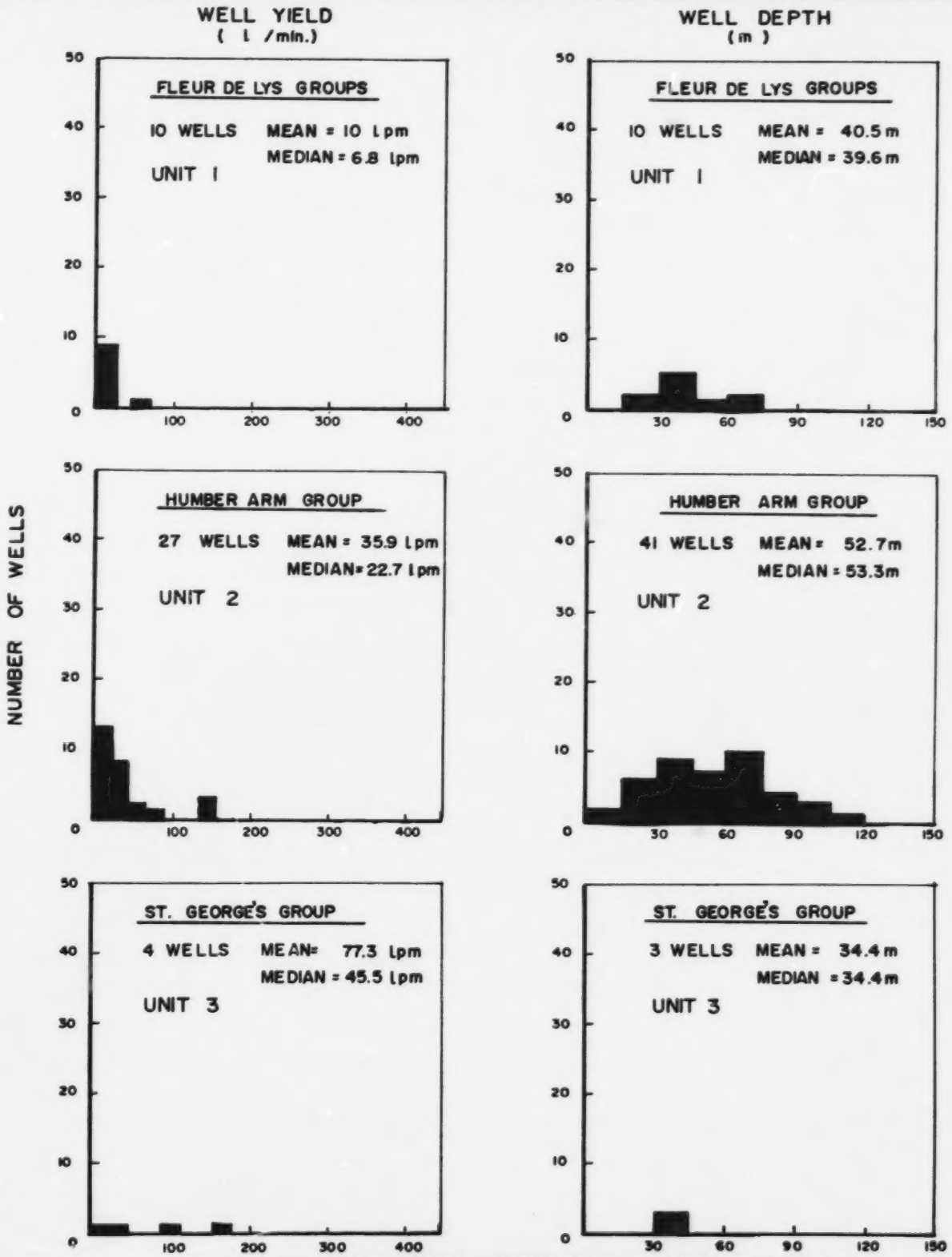
BEDROCK HYDROSTRATIGRAPHIC UNITS, HUMBER VALLEY AREA, NEWFOUNDLAND

Hydrostratigraphic Unit	Lithology	Total No. of Wells	Well Yield Characteristics				Well Depth Characteristics			
			No. of Wells	Range ℓ/min. (gpm)	Mean ℓ/min (gpm)	Median ℓ/min. (gpm)	No. of Wells	Range m (ft.)	Mean m (ft.)	Median m (ft.)
Unit 1 Fleur de Lys Group	schist	10	10	0.3-54.6 (0.06-12)	10 (2.2)	6.8 (1.5)	10	23-66.5 (75-218)	40.5 (133)	40 (130)
Unit 2 Humber Arm, Labrador Victoria Lake, and Sops Arm Groups	shale, phyllite quartzite, sandstone, conglomerate limestone, dolostone.	40	27	0-145.5 (0-32)	36 (7.9)	22.7 (5)	41	10-112 (33-368)	53 (173)	53 (175)
Unit 3 St. Georges Group	limestone-dolostone shale, phyllite	4	4	13.6-159 (3-35)	77.3 (17)	45.5 (10)	3	32-38 (104-124)	34.5 (113)	34.5 (113)
			28*	2.3-182* (.5-40)	75* (16.5)		9*		39* (128)	
Unit 4 Anguille and Deer Lake Groups	sandstone, conglomerate siltstone, mudstone	35	23	.5-91 (<.1-20)	21.8 (4.8)	17.3 (3.8)	35	11.5-181 (38-595)	53.5 (176)	46 (150)
Unit 5 Volcanic Groups	volcanics flows, tuffs, minor sediment	38	36	1-455 (.25-100)	58.2 (12.8)	22.7 (5)	38	14-107.5 (45-353)	42 (137)	33.5 (110)
		135**			29.1** (6.4)	18.2** (4)			46** (150)	
Unit 6 Ophiolite Complexes	ultramafic gabbro, sheeted diabase	14	8	2.3-18 (.5-4)	9.5 (2.1)	9.1 (2)	14	22-93 (73-305)	54 (177)	61 (200)
Unit 7 Granitic and Long Range Complexes	granite, granitic gneiss, diorite, porphyry	25**			20.5** (4.5)	9.1** (2)			42* (138)	

NOTES: * Nolan White and Associates Ltd., 1979
** Hydrology Consultants Ltd., 1980

WELL YIELD AND DEPTH DISTRIBUTION WITHIN FLEUR DE LYS, HUMBER ARM AND ST. GEORGE'S GROUP ROCK STRATA HUMBER VALLEY AREA, NEWFOUNDLAND

FIGURE 6

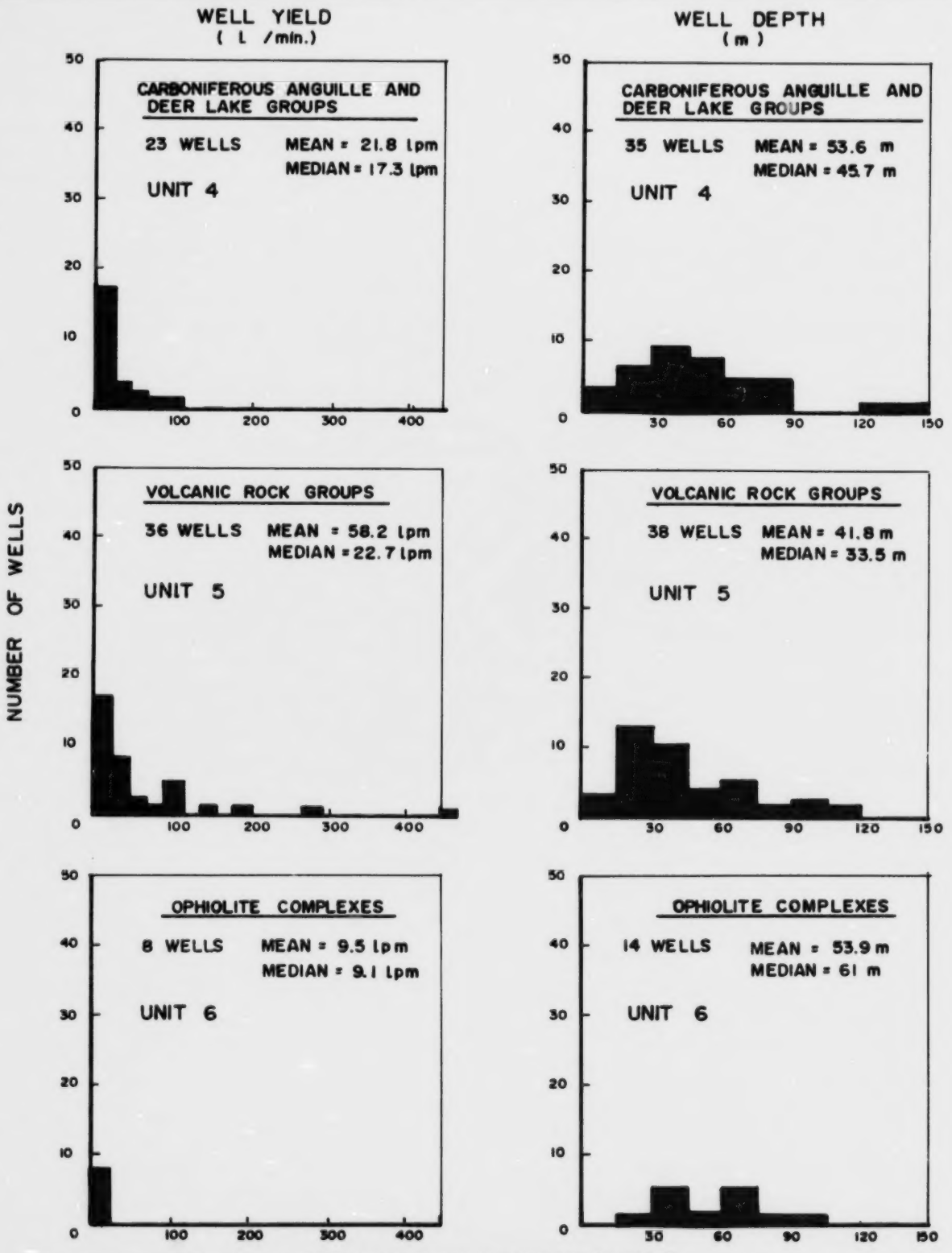


NOTE: UNIT NUMBERS REFER TO HYDROSTRATIGRAPHIC SUBDIVISIONS ON MAP 3.

Golder Associates

WELL YIELD AND DEPTH DISTRIBUTION WITHIN CARBONIFEROUS, VOLCANIC AND OPHIOLITE ROCK STRATA HUMBER VALLEY AREA, NEWFOUNDLAND

FIGURE 7



NOTE : UNIT NUMBERS REFER TO HYDROSTRATIGRAPHIC SUBDIVISIONS ON MAP 3.

Golder Associates

6.1.2.1 Unit 1 - Metamorphic Strata

Unit 1 includes the Late Precambrian to Cambrian age strata of the Fleur de Lys SuperGroup. This group was subdivided as a separate hydrostratigraphic unit based on the moderate to high grade metamorphic nature of its schistose rock strata.

This unit underlies much of the western half of the Burlington Peninsula adjacent to White Bay plus a second area of similar strata within the Long Range Mountains between Corner Brook and Pasadena, as shown on Map 3. Collectively, this unit underlies 10 percent of the study area.

A total of 10 well records were located for Unit 1, seven of which are located in the community of Pacquet. The well data indicates that the rock strata of Unit 1 has a low yield potential. The range of well yields varied between 0.3 and 55 ℓ/min recovered from well depths of 23 to 66 m (see Table 3). The mean well yield was 10 ℓ/min while the median yield was 7 ℓ/min from a depth of 40 m. The available data indicates that strata within Unit 1 are capable of producing a limited water supply adequate only for domestic purposes.

6.1.2.2 Unit 2 - Clastic Sedimentary Strata

Unit 2 includes the strata of the Humber Arm, Labrador, Victoria Lake and Sops Arm Groups. These groups are comprised predominantly of clastic sedimentary rocks including shale, phyllitic shale, greywacke, sandstone and quartzite plus minor limestone and dolostone. The strata of Unit 2 collectively underlie 12 percent of the study area.

Forty water well records were identified within the Unit 2 area, of which the majority are situated within the Humber Arm Group in the Corner Brook vicinity. The yield obtained from these wells ranges from 0 to 145 ℓ/min obtained from completed well depths of 10 to 112 m (see Table 3). The mean well yield is 36 ℓ/min and the median yield is 23 ℓ/min from a depth of 53 m.

The well records indicate that Unit 2 has a moderate groundwater yield potential capable of providing good domestic water supplies. As noted on Figure 6 some wells within the Humber Arm Group, are capable of yielding water in the range of 136 ℓ/min. Such yields are capable of meeting some commercial requirements, a point of significance in the outlying developing areas to the Corner Brook vicinity.

6.1.2.3 Unit 3 - Carbonate Strata

Unit 3 is comprised of limestone and dolostone of the St. George's Group. These strata are considered to potentially comprise the most extensive bedrock aquifer within the Humber Valley area.

The St. George's Group underlies approximately 4 percent of the Humber Valley area forming the rugged highlands of the Long Range Mountains extending north from Corner Brook through Old Mans Pond to Bonne Bay. Geological reconnaissance within this area has indicated that karst weathering is a significant factor within the underlying carbonate terrain (Wilkinson, 1983). Specifically, several occurrences of disappearing streams were noted in addition to small lakes and ponds with apparent internal drainage. In an area of moderately high precipitation these features suggest that the permeability of the underlying bedrock is quite high. This situation is considered common within structurally disrupted carbonate terrain that has been affected by karst weathering.

The potential water bearing capability of the carbonates of the St. George's Group has been locally demonstrated at the Daniel's Harbour lead-zinc mine located to the north of the study area. The hydrogeology of this mine was discussed in Water Resources Report 2-1 for the Great Northern Peninsula area (Nolan, White and Associates Ltd., 1979). Large water inflows are reported to emanate from open jointing and bedding planes that have been accentuated by solution weathering. The inflows vary seasonally from 36,000 to 70,000 ℓ/min based on mine pumping rates (Mitchell, 1983).

Water well information for the St. George's Group within the Humber Valley area is limited to 4 wells that have a yield range of 14 to 160 ℓ/min obtained at depths of 32 to 38 m (see Table 3). Additional well data was obtained from the Northern Peninsula (Nolan, White and Associates Ltd., 1979) where 28 wells exhibit yields of 2 to 182 ℓ/min. The mean yields calculated for these rocks in the Humber Valley and Great Northern Peninsula study areas are 77 and 75 ℓ/min respectively obtained at average depths of 34 to 39 m, respectively.

The potentially high yield characteristics of Unit 3 are considered of significance for water production only in the populated areas of Corner Brook and the Rocky Harbour-Norris Point vicinities. Elsewhere within the Humber Valley area this unit occurs in wilderness areas where its significance as an aquifer is largely restricted to the augmentation of surface water baseflow.

6.1.2.4 Unit 4- Carboniferous Strata

The Carboniferous age sedimentary rock strata of the Anguille and Deer Lake Groups comprise Unit 4. These strata underlie approximately 12 percent of the study area and form the lowland basin of the Deer Lake, Grand Lake and Upper Humber River valleys.

Much of the rock strata within Unit 4 is comprised of red bed sequences including mudstone, siltstone and indurated sandstone. The well yields for these strata are correspondingly low to moderate as shown on Figure 7.

A total of 35 well records were located for Unit 4. They indicate that well yields range from less than 0.5 to 91 ℓ/min obtained from well depths of 12 to 181 m (see Table 3). The mean and median well yields are 22 and 17 ℓ/min respectively, obtained at depths of 54 and 46 m.

The available well records indicate that the Carboniferous strata are capable of providing wells with low to moderate yields for single dwelling domestic purposes. However, water quality considerations

related to high salinity give cause for local constraint in the use of groundwater from these strata (see discussion in Section 6.4.3).

6.1.2.5 Unit 5 - Volcanic Strata

The broad assemblage of volcanic rocks that occur within the study area have been grouped together into Unit 5. The volcanic rocks of this unit underlie approximately 15 percent of the Humber Valley area, being most prevalent in the eastern half.

Thirty-eight water well records were located for wells drilled within the volcanic terrain (see Table 3). A very broad range of water yields from 1 to 455 ℓ/min were reported attained from well depths of 14 to 108 m. This wide distribution is shown on Figure 7. The mean yield from these wells was 58 ℓ/min from 42 m. The fact that the median yield is lower at 23 ℓ/min from 34 m suggests that in general most of the volcanics yield a moderate water supply at relatively shallow depths.

These relationships of well yield versus depth of the volcanic rocks are also borne out by well records from the Notre Dame Bay area (Hydrology Consultants Ltd., 1980) (see Table 3). A total of 135 wells were drilled in the volcanic terrain of Notre Dame Bay. They encountered a mean yield of 29 ℓ/min and a median yield of 18 ℓ/min from an average depth of 46 m.

The moderate well yields obtained from the volcanics are considered quite adequate to supply single dwelling domestic requirements. These strata have also produced wells for communal water supplies in small communities between Southwest Arm and Halls Bay in the Notre Dame Bay area. This suggests that a similar potential may exist for providing community water supplies from sources within Unit 5 in the Humber Valley area.

6.1.2.6 Unit 6 - Ultramafic Strata

Unit 6 comprises the mafic and ultramafic intrusion suite of the ophiolite complexes within the Burlington Peninsula and Bay of Islands areas.

The Bay of Islands ophiolite complex underlies approximately 7 percent of the Humber Valley area where it forms barren, uninhabited mountains for which there is no hydrogeological data available. The Baie Verte-Betts Cove ophiolite complexes of the Burlington Peninsula underlie 1 percent of the study area, however, as they occur beneath areas inhabited by coastal communities, some 14 well records were identified.

This data is summarized on Figure 7. It indicates that rocks of Unit 6 have a low yield potential. The median yield for 8 wells was 9 ℓ/min obtained at well depths of 61 m. Such yields are suitable only for domestic requirements.

6.1.2.7 Unit 7 - Granitic Strata

The granitic terrain of the Topsails, Burlington Peninsula, and Long Range complex comprises Unit 7 as shown on Map 3. The various granitic and gneissic bodies of this unit collectively underlie 40 percent of the Humber Valley area. These areas, like the rocks of Unit 6, tend to form barren, rugged upland and mountainous terrain that is largely uninhabited.

No well information is available for the granitic terrain of the Humber Valley area. However, similar granitic terrain occurs in the adjacent study area of Notre Dame Bay (Hydrology Consultants Ltd., 1980). Twenty-five wells had been drilled in the granitic rock of the Notre Dame Bay area from which a mean yield of 20 ℓ/min was obtained from an average well depth of 42 m. The median yield of 9 ℓ/min suggests that the granitic rock has a low yield potential. It is anticipated that similar conditions will prevail in the granitic terrains of the Humber Valley area.

6.2 Groundwater Flow Systems

On a regional basis, the hydrogeology of the Humber Valley study area can be subdivided into several shallow groundwater flow systems superimposed on a deep groundwater flow system.

6.2.1 Shallow Flow Systems

The shallow groundwater flow systems are associated with the circulation of fresh groundwater in the surficial deposits and near surface bedrock. These flow systems are largely controlled by water table conditions and variations in topography.

For most practical considerations, the "water table" comprises the upper limit of entirely saturated rock and surficial deposits from which water can be obtained. The water table is located somewhat below the ground surface in the upland areas of the study area which form zones of groundwater recharge. In these areas, precipitation will infiltrate downward to the water table to enter these shallow groundwater flow systems. The water table locally comes to surface in the various wet lowland areas, ponds, lakes and along the stream courses within the region. These locations form zones of groundwater discharge where groundwater is introduced to the surface drainage system to form base flow in the streams. The extensive bog areas found throughout the study area, as shown on Map 1, are important areas of water storage. These areas tend to maintain high or perched water table conditions and prolong infiltration and runoff periods.

Groundwater will flow in the direction of slope of the water table from areas of higher to lower elevation. As the positions of the near surface water table across the study area approximates the contour of the surface topography, it is considered that the direction of shallow groundwater flow will subparallel the surface drainage pattern. Consequently, the recharge divides of the shallow groundwater flow system tend to coincide with

surface drainage basin divides. Similarly, groundwater discharge divides will tend to coincide with stream courses where groundwater is discharged as baseflow.

In the shallow flow systems, groundwater follows a relatively short flow path from areas of recharge to discharge. Consequently, the residence time of the water in the subsurface environment is short and the water quality is generally fresh.

6.2.2 Deep Flow System

Water that enters deep within the rock formations of the study area will flow in response to regional hydraulic gradients. These gradients reflect the regional topographic slope outward from the upland and mountainous areas such as the Topsails and Long Range Mountains toward regional discharge zones. These regional gradients are less affected by local topographic variations.

The groundwater in the deep flow system is recharged from the shallow flow systems. Once in the deep system, the groundwater is considered to flow towards areas of discharge, located along the Humber River Valley and in places along the major fault structures such as those shown on Map 2. The ultimate discharge zones are the coastal perimeters of the study area.

The groundwater flow paths are consequently relatively long with accordingly long residence times for the groundwater in the rock. These factors lead to increased concentrations of total dissolved solids in the groundwater, through the dissolution of minor amounts of carbonate, sulphate and halite mineralization encountered in the rock strata along the flow path.

In a regional groundwater flow system, the order of increase in total dissolved solids usually follows an evolutionary trend along the flow path from bicarbonate water to sulphate water and finally to chloride water (Freeze & Cherry, 1979).

Deep flow system discharge zones associated with upward groundwater flow occur within the Carboniferous basin of the Upper Humber River Valley. The flows were detected by deep exploration drillholes that encountered artesian groundwater conditions. Of specific note, one hole put down in Sir Richard Squires Memorial Park encountered artesian saline groundwater, (Hyde, 1983).

As the deep flow system paths will be affected by variations in the permeability of different rock units, the flow path geometry will be governed by the overall fracture pattern of the rocks and in particular the flow volumes will be a function of fracture aperture, frequency and interconnection. Due to the high degrees of induration of the rock within the study area, in most cases, intergranular porosity and hence intergranular permeability will be of little significance. Thus, the major deep groundwater flow paths can be inferred to follow significant fractured zones such as along the major fault structures.

An indication of the ability of the deep rock masses to yield water is provided by underground mining experience. Three deep mines are currently, or have recently been operating within the study area, the Price-Asarco operations at Buchans, and the Rambler Mines and Baie Verte Mines (formerly Advocate Mines) in the Baie Verte area. In terms of groundwater, these mines are all considered dry and have experienced no major groundwater inflows.

The Buchans mining operations have been extensively developed within volcanic rock strata. Discussion with the manager of Buchans Mines (Neary, 1983) has indicated that the only significant water inflows

to the mines occur in the old Lucky Strike and Oriental operations where the underground workings receive direct surface water runoff from open pits during rainy periods. Elsewhere, the Buchans underground operations are largely dry as indicated during the sinking of the McClain Mine shaft to a depth of 1100 m. Significant water inflows requiring grouting were experienced only within the upper portions of the shaft at depths of 68 and 169 m with minor inflows occurring at 257 m.

The Rambler Mine has been worked to a depth of 550 m over a strike length of 122 m within volcanic rock. The total pumping from the underground operation was evaluated at 450 ℓ/min of which half is considered to be from drilling and other service water sources. This indicates that groundwater inflows are very low (Grainger, 1983).

The Baie Verte asbestos operation comprises an open pit mine some 180 m deep by 1.5 km long and 0.8 km wide. This pit has been excavated within ultramafic and gabbroic rock of the Baie Verte Ophiolite Complex. Inflow to this pit has been estimated at 1800 ℓ/min, most of which is surface runoff (Blagden, 1983). Although the secondary permeability of the rock associated with this pit is low, local permeable fracture zones have been encountered during mining. These zones are localized along ultrabasic fault contacts where weathering of the rock has produced open, water bearing fractures. Moderately high groundwater inflows have been experienced for short periods from these zones. However, after a time, the flow has diminished suggesting that the fracture systems are not extensively connected.

The experience from these mines indicates that the amount of groundwater obtainable within the general bedrock mass diminishes with depth below the ground surface. The major areas of groundwater flow within the bedrock are therefore considered to be in the relatively near surface zone where secondary permeability features associated with weathered fractures predominate.

6.3 Groundwater Recharge

The quantity of groundwater recharge that occurs within the Humber Valley area has been assessed by examining the baseflow discharge of the Upper Humber River and Indian Brook drainage basins shown on Figure 8. The drainage from these basins is unregulated. It is monitored daily by Environment Canada stream gauge stations located near Reidville on the Upper Humber River and near Springdale on Indian Brook (Environment Canada, 1982a). The hydrographs for the 1981 daily stream flow data from both drainage basins are shown on Figure 9.

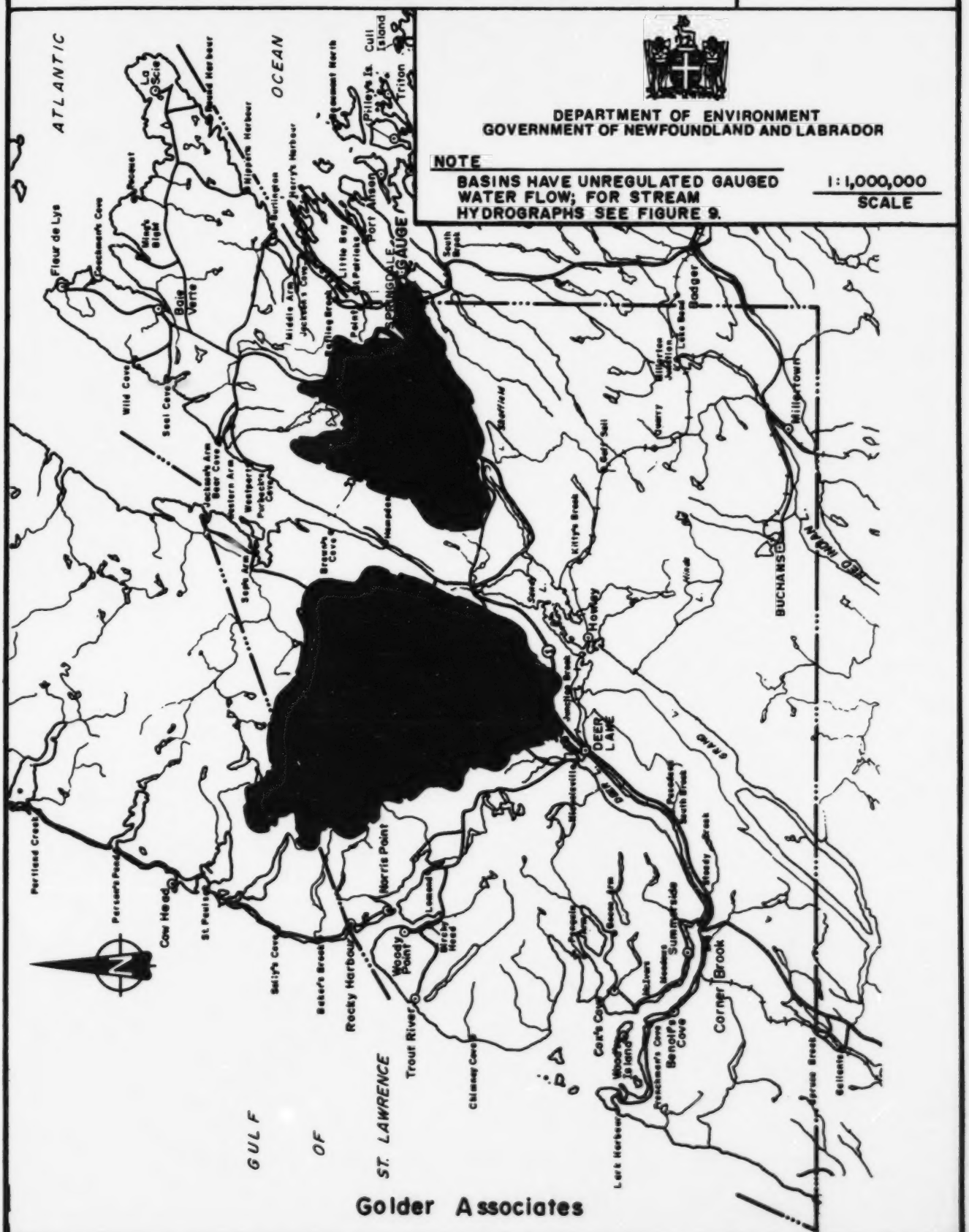
The volume of groundwater that is recharged to a drainage basin is considered to be approximated by the basin's baseflow discharge. Therefore, the separation of the baseflow component of the hydrographs as shown on Figure 9 provides an indication of the amount of water that is recharged to the respective basins. The baseflow discharge is separated from the hydrograph by joining the low peaks of the total stream flow. It should be noted that the baseflow discharge represented by the hydrographs includes both groundwater discharge and the slow release of surface water to the stream from storage in lakes and bog areas.

The sharp peaks shown on the graphs of Figure 9 represent surface water runoff. The main peak flow period observed in the months of April and May represents spring snowmelt runoff. The three smaller peaks occurring in August, October and December represent periods of high rainfall.

The hydrograph separations indicate that the 1981 baseflow component of the Upper Humber River drainage basin is approximately 60 percent of the total flow. This value is considered quite high and probably reflects stream flow augmentation from surface water storage in the extensive areas of bog within the drainage basin.

UPPER HUMBER RIVER AND INDIAN BROOK DRAINAGE BASINS
HUMBER VALLEY AREA, NEWFOUNDLAND

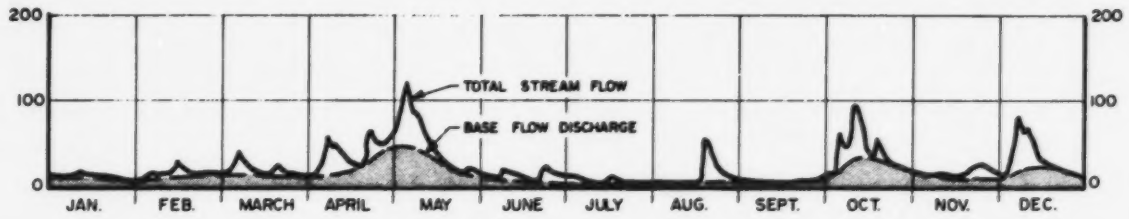
FIGURE 8



STREAM FLOW HYDROGRAPHS INDIAN BROOK AND UPPER HUMBER RIVER HUMBER VALLEY AREA, NEWFOUNDLAND

FIGURE 9

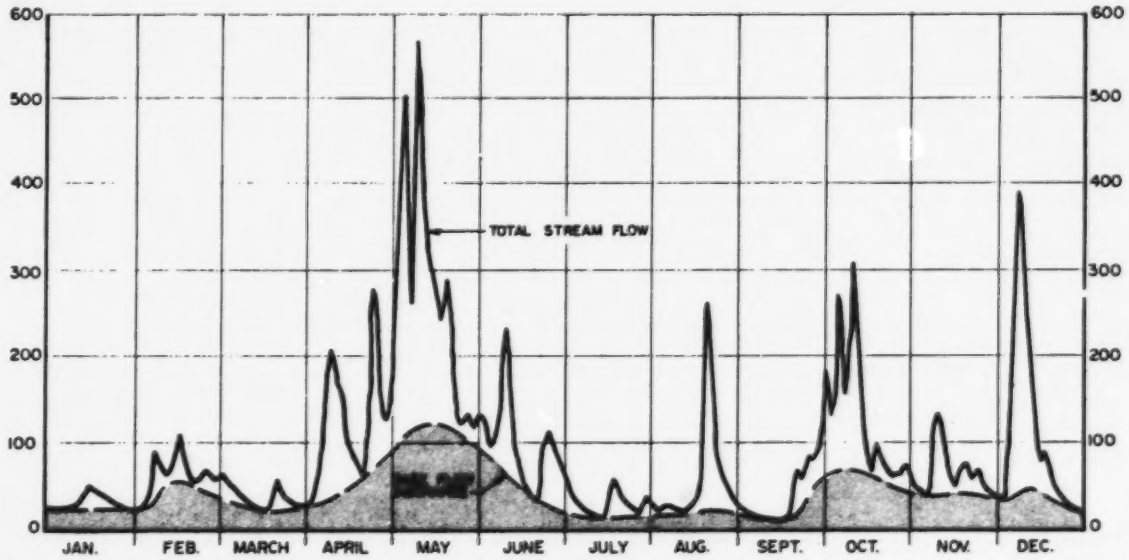
DAILY DISCHARGE IN CUBIC METRES PER SECOND



INDIAN BROOK DRAINAGE BASIN

1981 STREAM FLOW, INDIAN BROOK AT INDIAN FALLS, GAUGE STATION No. 02YM001.

DRAINAGE BASIN AREA = 974 km^2
TOTAL DISCHARGE = 7.26×10^6 m^3



UPPER HUMBER RIVER DRAINAGE BASIN

1981 STREAM FLOW UPPER HUMBER RIVER NEAR REIDVILLE, GAUGE STATION No. 02YL002.

DRAINAGE BASIN AREA = 2110 km^2
TOTAL DISCHARGE = 2.78×10^7 m^3

DATA FROM ENVIRONMENT CANADA, 1982a

Golder Associates

The baseflow component of Indian Brook provided from the 1981 hydrograph is approximately 46 percent of the total flow. The Indian Brook stream gauge was also used to calculate similar baseflow values of 43 and 37 percent for the 1975 and 1977 flow periods (Hydrology Consultants Ltd., 1980).

A comparison of total annual stream flow, baseflow and annual precipitation can be used to provide an indication of the water budget for the stream basins. In the case of Indian Brook approximately 1000 mm of precipitation falls annually on a drainage basin area of 974 km^2. Based on a baseflow of 46 percent, the approximated values of evapotranspiration, baseflow (including surface storage release) and runoff are as outlined on Table 4.

The value obtained by this approach for annual evapotranspiration is approximately 260 mm for an annual precipitation of 1000 mm. This estimate is approximately one-half of the lake evaporation value of 450 mm which has been recorded for this area (Canada Department of Transport, 1970). However, lake evaporation data is generally higher than the actual evapotranspiration that occurs from a drainage basin.

The baseflow of Indian Brook (Table 4) is 34 percent of the total precipitation that falls over the Brook's drainage basin. Assuming one half of this flow is from surface storage, the groundwater recharge component of baseflow would be 17 percent of the total precipitation.

A similar breakdown of stream flow for the Upper Humber River, assuming a higher annual precipitation of 1500 mm (because approxiamtely half of the drainage basin is located in the higher precipitation areas of the Long Range Mountains), gives values of evapotranspiration, baseflow and peak flow as listed on Table 5.

TABLE 4

WATER BALANCE

INDIAN BROOK DRAINAGE BASIN

HUMBER VALLEY AREA, NEWFOUNDLAND

Base Area	974 km^2
Discharge	7.26 x 10^6 m^3
Baseflow	46 percent (from Figure 9)
Precipitation	1000 mm (average)

TOTAL PRECIPITATION ON BASIN	9.74 x 10^6 m^3	100%
Evapotranspiration	2.48 x 10^6 m^3	25%
Baseflow (1)	3.34 x 10^6 m^3	34%
Runoff	3.92 x 10^6 m^3	40%

NOTE: (1) baseflow includes surface storage release and groundwater discharge

TABLE 5

WATER BALANCE

UPPER HUMBER RIVER BASIN

HUMBER VALLEY AREA, NEWFOUNDLAND

Basin Area	2110 km^2
Discharge	2.78 x 10^7 m^3
Baseflow	60 percent (from Figure 9)
Precipitation	1500 mm (assumed)

TOTAL PRECIPITATION ON BASIN	3.2 x 10^7 m^3	100%
Evapotranspiration	.42 x 10^7 m^3	13%
Baseflow (1)	1.67 x 10^7 m^3	52%
Runoff	1.11 x 10^7 m^3	35%

NOTE: (1) baseflow includes surface storage release and groundwater discharge

6.4 Groundwater Quality

Groundwater quality data for the Humber Valley area is largely limited to water analyses carried out on communal well water supplies by the Department of Environment. One specific groundwater quality investigation was undertaken in the Cormack-Deer Lake area by the Department of Environment to provide data on the local occurrences of saline groundwater.

In addition to the general composition of the water, the available chemical data from the study area has been compared to Health and Welfare Canada (1978) drinking water criteria to assess the acceptability of the various groundwater supplies.

The chemical data for various locations in the Humber Valley area are presented on Tables 6 to 11. It should be noted that some of the chemical data exhibits analytical errors. Where analysis include both major cation and anion species, charge balance errors* have been calculated to provide an indication of the analytical precision of the results. Charge balance errors of greater than 20 percent are considered to indicate large analytical errors in one or more species. Details concerning the methods of filtration and preservation of the samples prior to analyses were not available.

6.4.1 Overburden Groundwater Quality

Water quality data for wells completed in sands and gravels is available from the communal well in the Town of Gillams (Dominie, 1983) from 2 shallow domestic wells in Gros Morne National Park (O'Sullivan, 1976) and from several test wells put down in gravels at a proposed landfill site in Trout River. (Robinson, 1983).

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*Charge balance error (%) calculated as:(Total meq cations-Total meq anions)/(Total meq of cations plus anions) x 100

TABLE 6

OVERBURDEN GROUNDWATER QUALITY
TOWN OF GILLAMS AND DEER LAKE AIRPORT
HUMBER VALLEY AREA, NEWFOUNDLAND

Sample		Town of Gillams Communal Well Sample 1	Town of Gillams Communal Well Sample 2	Deer Lake Airport
Cond.	uS	606	-	500
pH		7.95	8.02	8.4
Na	mg/l	-	-	65
K	"	-	-	1.7
Ca	"	48	44	26
Mg	"	11.3	11.65	8.2
HCO_3	"	124	-	133
Cl	"	-	-	36
SO_4	"	-	26.5	75
NO_3 (as N)	"	< .005	-	< .01
TDS	"	-	218	-
Fe	"	-	<.01	< .05
Mn	"	.250	.221	.01
Zn	"	.021	-	-
Cu	"	<.01	-	-
Cd	"	<.01	-	-
Hardness (as $CaCo_3$)	"	168	158	99
Coliform		0	-	-

NOTE:

Well Construction

Town of Gillams - 152 mm cased well completed 12 m deep in gravel with 1.2 m screen
- long term safe yield 340 ℓ/min

Deer Lake Airport - 152 mm cased well completed 55 m deep in sandy silt to clayey silt overlying 4 m of water bearing gravel that is screened over 1.5 m
- long term safe yield 330 to 894 ℓ/min

TABLE 7

GROUNDWATER QUALITY

TROUT RIVER

HUMBER VALLEY AREA, NEWFOUNDLAND

Samples		A	B	C	D	1	2
Cond.	µS	520	400	420	60	470	470
pH		7.8	8.6	8.6	7.8	8.3	7.8
Na	mg/l	13.1	24.9	14.2	17.1	51.3	16.0
K	"	11.3	7.5	1.6	13.3	4.90	2.3
Ca	"	32.7	69.5	35.1	79.2	31.1	38.3
Mg	"	54.0	107.3	178.9	328.3	30.6	30.3
HCO_3	"	262	169	202	326	190	108
Cl	"	15.7	13.9	12.0	18.4	16	18
SO_4	"	5	26	18	8	-	-
NO_3 (as N)	"	.013	.034	.044	.039	.060	.015
TDS	"	328	252	264	408	-	-
Fe	"	16.0	29.1	30.6	84.2	8.78	3.34
Mn	"	5.83	1.86	3.64	7.84	.20	2.28
Zn	"	-	-	-	-	.93	2.38
Cu	"	.12	.25	.48	1.0	.08	.06
Pb	"	.048	.036	< .01	.771	.004	.014
Cd	"	.008	.008	.009	.019	.005	.005
Hardness (as $CaCO_3$)	"	343	671	885	1714	203	219
CBE*	%	23	60	64	71	31	40

NOTE:

* charge balance error

1) water samples collected from test wells installed in sand and gravel deposits

TABLE 8

GROUNDWATER QUALITY

GROS MORNE NATIONAL PARK

HUMBER VALLEY AREA, NEWFOUNDLAND

Samples		Deep Well Rocky Harbour 1980	Spring 1981	Shallow Well Belldowns Pt 1982	Shallow Well Sally's Cove 1983
Cond.	µS	706	129	188	202
pH		7.2	7.4	7.2	7.0
Na	mg/l	170	5.8	16	18
K	"	12	.6	2.7	1.3
Ca	"	6.2	23	17	18
Mg	"	2.1	1.4	4.2	9.0
HCO_3	"	29.6	69.8	58.5	86.5
Cl	"	90	7.4	28	22
F	"	.22	.10	.10	.10
SO_4	"	10	5	10	7
NO_3 (as N)	"	.04	.31	.65	.04
TDS	"				
Fe	"	.26	.05	1.05	.06
Mn	"	.01	.01	.14	.02
Zn	"	.170	.014	1.15	.013
Cu	"	.015	.002	.003	.002
Pb	"	.002	.002	.004	.004
Cd	"	.001	.001	.001	.001
Hardness (as $CaCO_3$)	"	24.1	63.2	59.8	82.0
CBE*	%	43	2.3	0.8	6.0

* charge balance error

TABLE 9

GROUNDWATER QUALITY
COMMUNAL WELLS
GREEN BAY DISTRICT
NOTRE DAME BAY AREA, NEWFOUNDLAND

Community		Sandy Brook	Beach-Side	Harry's Harbour	St. Patricks	Jackson's Cove	Langdon's Cove
Conductance	µS	184	321	210	480	323	545.5
pH		7.2	8.6	7.2	7.6	8.4	9.1
Ca	mg/l	18.5	19.6	28.2	51.3	11.9	13.1
Mg	"	3.4	4.9	2.7	7.0	3.7	5.7
HCO_3	"	37.3	126	70	83	122	128
NO_3 (as N)	"	1.2	.02	2.7	.2	.3	.07
Fe	"	.03	.010	.04	.02	< .01	.046
Mn	"	.03	<.01	.01	.017	.022	.021
Zn	"	<.01	.010	.60	.03	.054	.087
Cu	"	<.04	<.01	.05	.04	<.01	<.01
Cd	"	<.005	<.005	<.005	<.005	<.01	<.01
Hardness (as $CaCO_3$)	"	60.3	69	82	157	45	56

Note: (1) Communities listed are located along south shore of Southwest Arm situated immediately outside the limits of Humber Valley study area.

TABLE 10

GROUNDWATER QUALITY

FLOWING ARTESIAN DRILLHOLE

SIR RICHARD SQUIRES MEMORIAL PARK

CORMACK AREA

HUMBER VALLEY AREA, NEWFOUNDLAND

SAMPLE		SAMPLE 1	SAMPLE 2
Cond.	µS		
pH		4.8	4.5
Na	mg/l	53700	55000
K	"	165	162
Ca	"	2450	2450
Mg	"	590	590
Fe	"	15	15
HCO_3	"	5	5
Cl	"	133000	133000
SO_4	"	615	615
Hardness (as $CaCO_3$)	"	8547	8547
CBE*	%	22	22

* charge balance error

TABLE 11

GROUNDWATER QUALITY OF PRIVATE WELLS

CORMACK AREA

HUMBER VALLEY AREA, NEWFOUNDLAND

Sample #		1	2	3	4	5	6	7	8	10	11
Cond.	µS	8434	1855	350	6627	36	2577				
pH		8.1	8.0	8.9	8.2	6.7	9.0	5.6	5.7	5.5	5.5
Na	mg/l	1444	3042	29.0	873.4	2.1	1518	25.4	252.2	25.2	975.7
K	"	5.6	11.3	2.7	5.0	.5	2.4	.9	.45	1.2	2.7
Ca	"	60.6	321.0	13.3	61.8	2.3	24.3	94.9	1.3	35.2	46.0
Mg	"	37.6	141.1	7.0	21.7	.6	7.1	38.9	.3	14.7	20.2
Fe	"	.2	.5	3.1	.4	.2	.04	.17	.05	.02	.03
HCO_3	"	159	113	92	210	7	185	2	1	< 1	< 1
Cl	"	269 (1953)*	615 (4295)*	22	207 (949)*	10	320 (1954)*	30	29	79	263 (355)*
SO_4	"	500	700	22	560	8	760	31	68	12	543
NO_3 (as N)	"	.14	.40	.07	.15	<.005	.04				
H_2S	"	.019	.022	.142	.012		.009		odour		
TDS		5118	11903	286	4074	55	1719	506	460	38	3215
Hardness (as $CaCO_3$)	"	306	1383	68	244	9	90	397	4	149	198
CBE+	%	54	65	2	34	37	42	72	67	24	42
Quality		saline	saline	fresh	saline	fresh	saline	fresh	fresh	fresh	saline

NOTE: * chloride values estimated from cation and anion molar equivalent balances.
+ charge balance error

1) bicarbonate (HCO_3) and pH values of samples 7 to 229 are not considered representative of actual groundwater conditions.

TABLE 11 (cont'd)

GROUNDWATER QUALITY OF PRIVATE WELLS
CORMACK AREA

HUMBER VALLEY AREA, NEWFOUNDLAND

Sample #	12	14	16	17	19	23	25	26	27	29	31	229
Cond. µS												
pH	5.3	5.3	5.3	4.3	5.5	5.15	5.0	5.0	4.9	4.8	7.07	5.2
Na mg/l	16.6	53.3	14.6	17.1	155	7.6	119.8	20.2	36.7	365.8	197.9	413.5
K "	.7	1.1	.8	1.0	.6	.5	.7	.58	.7	3.3	.5	2.0
Ca "	22.7	4.9	41.8	81.4	1.7	21.9	1.9	20.7	9.6	69.9	2.0	17.5
Mg "	8.3	2.6	15.1	29.9	.5	5.6	.6	7.9	4.4	12.2	.6	5.7
Fe "	.01	1.13	.15	.02	.05	.02	.02	.02	.16	.04	.02	.02
HCO_3 "	< 1	1	1	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1	1
Cl "	26	33	32	164	94	18	53 (178)*	6	6	22	16 (248)*	644
SO_4 "	7	19	10	14	4	5	13	40	9	1663	58	5
NO_3 " (as N)												
H_2S "					odour					odour		
TDS "	164	273	272	856	579	137	512	172	148	1544	36	1662
Hard- " ness (as $CaCO_3$)	34	11	62	326	6	78	7	84	42	225	7	67
CBE+ %	48	36	56	19	42	52	49	44	86	26	67	2
Quality	fresh	fresh	fresh	fresh	fresh	fresh	fresh	fresh	fresh	saline	fresh	saline

NOTE: * chloride values estimated from cation and anion molar equivalent balances.

+ charge balance error

1) bicaronate (HCO_3) and pH values of samples 7 to 229 were not considered representative of actual groundwater conditions.

As previously mentioned, the communal well in the Town of Gillams is 12 m deep and comprises a 152 mm diameter steel casing with a 1.2 m screen section. The safe yield for this well determined from an engineered pump test is 340 ℓ/min. The data from chemical analyses of 2 water samples from this well are listed on Table 6. The data indicates that the water is a fresh, hard, calcium bicarbonate water with a moderate total dissolved solids concentration in the order of 200 mg/l. The dissolved heavy metal concentrations within the water are low and within acceptable water quality criteria. However, the concentration of manganese is somewhat elevated, in the order of 0.220 to 0.250 mg/l compared to an acceptable limit of 0.05 mg/l. Elevated manganese concentrations within the water will tend to give rise to aesthetic problems as a result of staining in a manner similar to iron.

The analytical results of a water sample recovered from the Deer Lake Airport water supply well discussed previously are also listed on Table 6. This sample was obtained following a 72 hour pumping test (Environment Canada, 1980) and being somewhat similar in quality to the Town of Gillams well, indicates the high water quality obtainable from the surficial aquifers.

Groundwater samples from test wells installed in gravels at a proposed landfill site in Trout River were collected and chemically analysed by the Department of Environment. The data from 6 analyses is presented on Table 7. The groundwater within the gravels is fresh, very hard, calcium magnesium bicarbonate water.

The magnesium concentrations within the water as listed on Table 7 are largely responsible for the hardness reported. However, the charge balances for these water samples suggest that large analytical errors exist for the analyses of samples B, C and D of Table 7. The analytical accuracy of the high magnesium concentration of 107 to 328 mg/l are suspected to be a major cause of the indicated analytical error.

Analysis A on Table 7 has a moderately acceptable charge balance error and is considered representative of the in situ groundwater quality. The iron and manganese concentrations of 16.0 and 5.8 mg/l respectively, from this sample are extremely high for domestic water sources. Concentrations of these levels would result in excessive brown iron staining on plumbing fixtures and clothing plus the formation of iron and manganese hydroxide precipitates if the water were utilized for domestic purposes.

The groundwater from the shallow domestic wells at Belldowns Point and Sally's Cove in Gros Morne National Park (see Table 8) is a fresh, soft, calcium bicarbonate water. Iron and manganese concentrations are slightly elevated in the Belldowns Point sample but are within water quality criteria in the Sally's Cove sample. Of particular note, the fluoride concentrations of these water samples are 0.1 mg/l, much lower than the 1.0 mg/l concentrations recommended for dental health.

In summary, from the available water quality data, the surfical deposits provide a good quality supply of fresh groundwater. The major ionic constituents in the water are calcium or calcium magnesium bicarbonate with occasional elevated concentrations of iron and manganese.

6.4.2 Bedrock Groundwater Quality

The groundwater quality of several communal water supply wells in the coastal communities of the Green Bay District are regularly monitored by the Department of Health. These communites are situated immediately east of the Humber Valley study area. Analytical results of well samples from this district are listed on Table 9, (Beson, 1983).

The wells from which the samples have been taken were all completed in volcanic rocks. The analyses listed on Table 9 indicate that the water is of a variable soft to hard nature. Calcium and bicarbonate are the principal dissolved species and heavy metals are within acceptable

levels. No data was available concerning sodium and chloride concentrations. As these analyses all originate from the same rock type as Hydrostratigraphic Unit 5, they are considered to be representative of groundwater produced from the volcanic terrain throughout the study area. No groundwater quality data was available for the granitic terrain, or for the St. George's or Humber Arm Groups.

However, based on carbonate mineral content within the bedrock, groundwater from the granitic areas is anticipated to be somewhat lower in calcium bicarbonate content and hence softer than that of the volcanic terrain. Conversely, the limestone and dolostone terrain of the St. George's Group will produce groundwater of a hard, alkaline, high calcium and magnesium bicarbonate nature. Groundwater from the Humber Arm Group is anticipated to produce alkaline water of an intermediate composition.

6.4.3 Cormack Special Study Area

6.4.3.1 Saline Groundwater

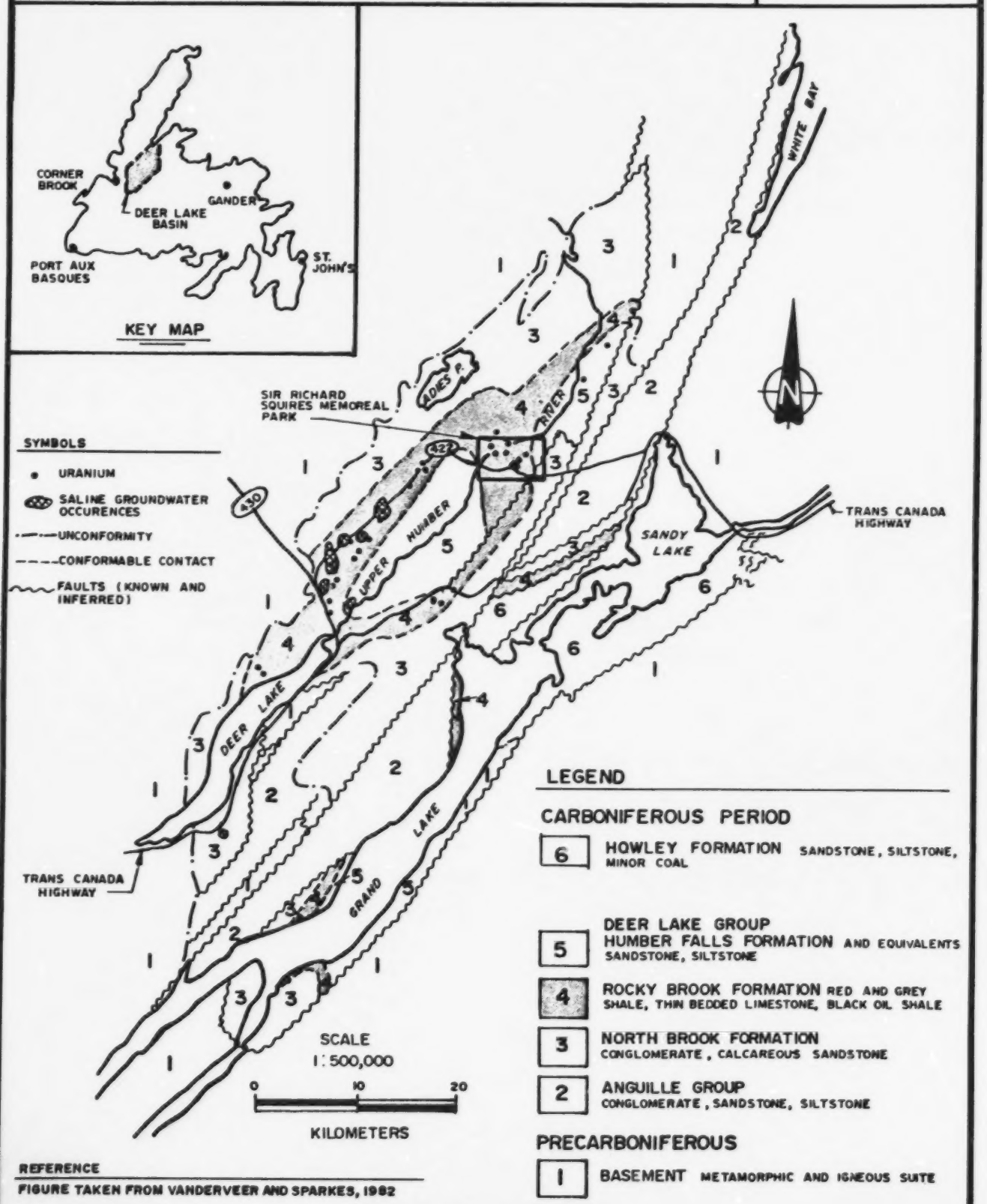
The quality of well water within the vicinity of Cormack was investigated by the Department of Environment in 1979 to assess the extent of the occurrence of saline groundwater within the area (Robinson, 1983). The Cormack study area is a farming community located along Highway 422 between the Town of Deer Lake and Sir Richard Squires Memorial Park within the Upper reaches of the Humber River Valley (see Figure 10).

The land surface within the Cormack area is relatively flat and slopes gently southeastward at 1.5 to 1.8 percent toward the river. The ground surface elevation varies from 76 to 168 m. The northwest perimeter of the area is marked by the steep rise of the Long Range Mountains to elevations of 380 m.

The ground surface at Cormack is largely underlain by glacial till of local bedrock derivation. The bedrock is comprised of Carboniferous age red-bed strata of the Deer Lake Group.

GEOLOGY, SALINE GROUNDWATER OCCURRENCES AND URANIUM MINERALIZATION IN CARBONIFEROUS STRATA, HUMBER VALLEY AREA, NEWFOUNDLAND

FIGURE 10



REFERENCE

FIGURE TAKEN FROM VANDERVEER AND SPARKES, 1982

Golder Associates

These strata are subdivided into three formations as shown on Figure 10. The North Brook Formation lies unconformably over the Paleozoic basement in the Cormack area. It is comprised of basal conglomerates that grade upward into calcareous sandstones. These strata are overlain by the Rocky Brook Formation which is comprised of red and grey shales, thin limestone beds and black oil shale beds. The uppermost member is the Humber Falls Formation comprised of sandstones and siltstones. The entire sequence is synclinally folded about a northeast-southwest axis that subparallels the Upper Humber River. The total depth of strata at the centre of the basin varies from 460 to 730 m.

The Cormack area is in a discharge zone where upward movement of groundwater predominates as noted by the large number of flowing artesian wells located within the area. The accompanying recharge zone is considered to be situated on the flanks of the Long Range Mountains to the northwest.

Saline groundwater has been encountered within the bedrock overlying this area, from several wells and exploration drillholes. The occurrence of saline groundwater was reported to the Department of Environment in the spring of 1979 by Dr. R. Hyde, Department of Mines and Energy (Robinson, 1983). He noted saline groundwater flowing from an abandoned artesian gas exploration drillhole some 450 m deep, located in Sir Richard Squires Memorial Park. The analytical results of 2 water samples collected by Hyde from this well are listed on Table 10. The dissolved sodium and chloride concentrations of 55000 and 133000 mg/l respectively from this water are close to sodium chloride salt saturation. Hyde also made note of another saline artesian well located in Middle Branch Rocky Brook adjacent to Highway 422.

The Department of Environment responded to this report of saline groundwater by immediately carrying out a field investigation within the area. During the investigation, 22 drilled private wells within the Cormack area were sampled for chemical analysis. The results of these analyses are listed on Table 11. The wells sampled were all of relatively shallow depth varying from 12 to 76 m.

A total of 7 out of the 22 wells sampled had saline water as noted on Table 11. The primary constituents contributing to the salinity are sodium and chloride although elevated concentrations of sulphate are significant. The odour of hydrogen sulphide was also noted from several wells.

The charge balance errors of the samples reported on Table 11 indicate large analytical errors. These errors are considered to be primarily in the chloride analyses. The reported range of chloride analysis of the saline water samples vary from 207 to 644 mg/l. However, under the assumption that the reported sodium concentrations are correct (413 to 3042 mg/l) the anticipated chloride concentration should be in the range of 355 to 4295 mg/l based on molar equivalents of ions. The maximum acceptable concentration of chloride in drinking water is 250 mg/l, above which salt taste becomes noticeable.

The associated sulphate concentrations within the saline well water samples were found to range from 500 to 750 mg/l (see Table 11). One sample (No. 29, Table 11) from a well located near Reidville contained extremely high sulphate concentrations (1663 mg/l) with virtually no chloride, (22 mg/l) indicating a sodium sulphate type water. Again, the ion balance of this sample was poor which may be due in part to error in the cation analyses. Sulphate concentrations of 1600 mg/l in groundwater are indicative of gypsum saturated conditions. The maximum acceptable concentration of sulphate in drinking water is 500 mg/l, above which taste and physical effects such as catharsis and gastrointestinal irritation become significant.

The samples of fresh water obtained from wells located between the saline water occurrences are characteristically calcium bicarbonate water with significant sodium and chloride concentrations (see Table 11). The total dissolved solids of these fresh water samples range from 36 to 512 mg/l.

The occurrences of saline water within the Cormack area are indicated on Map 3 and Figure 10. An additional occurrence of saline water was reported by Waltsons Well Drilling from a well completed in similar rock strata in the Pasadena area (Gale, 1983).

As noted on Figure 10, the locations of reported saline groundwater observations spatially correlate with the Rocky Brook Formation. However, the occurrences are sporadic such that an adjacent well drilled within a hundred metres of a saline well will encounter fresh water.

From the available information, the salinity within the groundwater of the Cormack area is considered to originate from the Rocky Brook Formation or from the upper portion of the North Brook Formation. Thin bedded limestone is reported from these sequences indicative of ancient evaporitic lake environments (Hyde, 1979), which may also be associated with minor halite (NaCl) and gypsum ($CaSO_4.2H_2O$) mineralization.

It is considered that groundwater coming in contact with trace mineralization of this nature along its flow path through these formations would tend to accumulate dissolved sodium, calcium, chloride and sulphate within the range of the concentrations observed in the Cormack area. The odour of hydrogen sulphide and the elevated iron concentrations may be derived from anaerobic decomposition of bitumen within the black oil shales of the Rocky Brook Formation. The brine water flowing from the drillhole in Sir Richard Squires Memorial Park suggests that this water has come into direct contact with significant salt bearing strata within the basin.

In summary, saline groundwater can be anticipated from wells drilled in areas underlain by the Rocky Brook and North Brook Formation. In addition, hydrogen sulphide odour plus elevated iron concentrations can be expected from wells completed in the black oil shales of the Rocky Brook Formation. It should also be noted the water occurrences of these types are not uniform throughout the area underlain by Rocky Brook Formation, such that fresh groundwater supplies are also available.

6.4.3.2 Uranium

In addition to saline groundwater, the Rocky Brook Formation within the Upper Humber River Valley is known for the occurrence of uranium mineralization. In the past several years, uranium exploration has been carried

out within this area by Westfield Minerals Limited. Their exploration activity in conjunction with geological mapping by the Department of Mines and Energy has outlined zones of low grade uranium mineralization as shown on Figure 10.

Due to these known occurrences, concern has been raised regarding uranium and its decay products, including Radium-226 and Radon-222 in the groundwater. Westfield Minerals Limited personnel undertook a monitoring program to access the concentrations of uranium, Radium-226 and Radon-222 in the groundwater both as an exploration indicator and as a check on surface water quality resulting from exploration drilling (Wilkinson, 1983).

The concentrations of uranium in both surface water and groundwater from drillholes was found to be generally less than 1 part per billion and the maximum concentration encountered was 16 ppb. Health and Welfare Canada (1978) has set a maximum acceptable concentration limit for uranium in drinking water of 0.02 mg/l. This standard is approximately 10 times greater than the actual concentrations encountered.

Radium-226, a decay product of uranium-238, was found not to exceed 0.019 Becquerels per litre in surface and groundwater associated with uranium mineralization. This is approximately 5 times lower than the maximum acceptable concentration of 0.1 Becquerels per litre allowable in drinking water.

Radon-222 is an inert gas that forms as a decay product of Radium-226. The concentrations of this gas in surface and groundwater as determined by scintillometer measurement was found to vary between 40 and 80 picocuries per litre. A maximum concentration of 425 picocuries per litre was encountered in water from a drillhole put down along one of the Birchy Ridge faults. These radon concentrations are near background levels considering that 50 percent of the tested wells in the United States

contain in excess of 500 picocuries per litre of radon (United States Environmental Protection Agency, 1977).

From the available data, the occurrence of low grade uranium mineralization within the bedrock of the Upper Humber River Valley does not appear to present a health hazard in either the surface water or the groundwater.

6.5 Groundwater Contamination

Within the study area, the major area of concern for groundwater contamination is considered to be bacterial contamination of shallow dug wells. Wells of this nature predominate in many of the small and rural communities. Human bacteria from septic or cesspool systems plus outhouses and domestic animal bacteria can be introduced to a shallow well by either direct infiltration or surface runoff.

Infiltration of bacteria to a well is usually encountered where the well is shallow and located very close to the pollution source. Elevated nitrate concentrations are also associated with this type of situation. Problems encountered with surface runoff tend to be related to poor well construction that allows the direct introduction of surface water. The effect may be of shorter duration than that associated with infiltration. Bacterial contamination is largely eliminated with deep, properly cased and sealed drilled wells.

Pathogenic viruses that are responsible for diseases such as Hepatitis and Polio can contaminate groundwater. Unlike bacteria, viruses are able to persist for some time in the subsurface environments. This persistance plus the mobility of these extremely small organisms within an aquifer is significant in contrast to bacteria which tend to be readily absorbed on soil particles. Infiltration from municipal sewage systems and private spetic systems can provide a source of viral contamination in groundwater. Areas that are particularly susceptible to

this type of contamination are associated with aquifers of high permeability such as outwash gravels and highly fractured or karst bedrock. Several instances of groundwater contamination of infectious viruses have been sited, notably one instance of infectious Hepatitis Epidemica viruses at Mount Allison University in Sackville, New Brunswick (Matthess, 1982). The potential impact of this type of contamination can be reduced through the proper location of disposal sites for municipal sewage effluent and sewage sludge relative to areas of groundwater use plus the use of water purification.

Petroleum contamination of well water supplies can result from a variety of sources including leakage to the groundwater from buried storage tanks and surface spills. Petroleum spills tend to float on the surface of the water table; however, more volatile components such as the phenols are soluble in the groundwater. Contamination of this nature including even minor spills can destroy water supplies from shallow dug wells. Deep drilled wells are less vulnerable but can also be affected.

In addition to petroleum products, commonly used chlorinated organic solvents can cause contamination of groundwater. These types of industrial solvents are used for cleaning and degreasing purposes and may be encountered in various places such as machine shops, automotive, mechanic and paint shops, asphalt plants and dry cleaning shops. Some commonly used examples of these solvents are trichloroethane (methyl chloroform), tetrachloroethane (dry cleaning solvent), trichloroethane and tetrachloromethane (carbon tetrachloride). These chemicals are soluble in water to concentrations of 150 to 4400 mg/l and somewhat denser than water having specific gravities of 1.35 to 1.60. Also, they do not readily break down such that once introduced they tend to persist in groundwater and migrate with the groundwater flow. They are generally introduced to the groundwater through disposal methods such as dumping in municipal landfills or industrial yards and storm drain systems. Concentrations of these solvents in the order of a few parts per billion can result in the water becoming unfit for consumption.

Road salt can present a local problem to well users where the well is situated in close proximity to drainage off a roadway. Again, shallow dug wells are the most susceptible to this form of contamination.

Salt water intrusion may cause problems for drilled wells located alongside the ocean in cases where they are drilled to a depth below sea level. In general, though, the coastal areas are zones of fresh groundwater discharge associated with upward hydraulic gradients. However, excessive pumping from a well, specifically communal wells may reverse this gradient resulting in the intrusion of sea water into the water bearing formation. This phenomenon is most prevalent in lowland coastal areas where the natural hydraulic gradients are weak. To date, no reference to problems related to sea water intrusion have been noted within the study area. This may in part reflect the influence of the generally steep sloping coastline within the study area on groundwater gradients. However, areas of potential risk for salt water intrusion due to low coastal topography are considered to occur in the York Harbour area of the Bay of Islands and the Norris Point-Rocky Harbour areas of Bonne Bay.

Municipal landfill sites present a potential groundwater contamination problem but currently, due to the limited population, they are not a significant factor within the study area. Groundwater leachate derived from municipal landfills characteristically has elevated concentrations of chloride, sulphate, iron and dissolved organic constituents that may render the water unfit for domestic consumption.

Care in the placement of landfills and the location of wells can greatly reduce the impact of groundwater contamination. In an area such as the Humber Valley where rainfall is relatively high, any exposed landfills will correspondingly receive a significant infiltration. Consequently, it is desirable to locate any proposed waste dump sites in areas of overburden sufficient for burial and which will also allow sufficient infiltration to prevent the formation of surface leachate springs. Areas of thick glacial till deposits are desirable for this purpose. Sand and gravel deposits due to their potential as aquifers are less desirable but may be acceptable in remote regions where groundwater supplies are not used.

In addition to municipal landfills, bark waste landfills and mill effluent from pulp and paper processing can also present a groundwater contamination problem. These wastes are capable of generating a leachate liquor consisting of tannic acids, sulphate, sodium hydroxide and various dissolved organic constituents with associated high biological oxygen demand. This liquor can seriously degrade the groundwater quality within a surficial deposit or bedrock aquifer. Considerable care must therefore be exercised when locating any such new facilities. From this viewpoint, however, it is fortunate that to date pulp and paper waste landfilling has not been undertaken within the study area. The existing mill located in Corner Brook has historically utilized ocean disposal methods for wastes and more recently some fibre wastes have been utilized as hog fuels for steam boilers.

The major industrial wastes stored on surface within the study area are mine tailings and dumps of mine waste rock. Tailings and waste rock containing sulphide mineralization are currently being produced at Rambler Mines and have been produced at Buchans and Gullbridge Mines. Oxidation of the sulphide minerals within the tailings and waste rock has the potential for developing acid drainage associated with low pH, high dissolved iron and sulphide concentrations, and elevated concentrations of heavy base metals such as copper, lead and zinc. Acid drainage of this nature presents a potential both for surface and groundwater contamination. The extent to which acid drainage will develop is largely dependent upon the carbonate mineral content of the tailings. Discussions with Government and Industrial officials during the preparation of this report has indicated that acid drainage is currently not a major problem.

Asbestos mining in the Baie Verte area produces large quantities of tailings that contain very fine asbestos fibre particles. The fibres are not known to be a problem in groundwater; however, they can be of major significance in surface runoff where the water is used for drinking water. Although these comments are addressed to the mine waste dumps, it should be noted that a similar situation of high asbestos fibre concentration occurring in surface waters can arise from natural drainage flowing over some of the areas of ultramafic bedrock.

6.6 Surface Water Quality

Surface water quality data has been collected by Environment Canada at 2 stream gauge stations within the Humber Valley area, one located near Reidville on the Upper Humber River and the other near Springdale on Indian Brook. A summary of this data collected over the period from 1965 to 1980 has been published by Environment Canada (1982b). The variations in selected chemical constituents reported in this data are presented on Table 12 of this report.

In assessing the data presented on Table 12, it must be noted that the chemical constituents dissolved in the surface waters are from areas largely unaffected by human activity, accordingly they are likely to be significantly influenced by the composition of the baseflow originating from groundwater discharge. Thus, the concentration of the dissolved constituents are a product of dilution of groundwater baseflow discharge by surface water runoff and direct precipitation.

A large proportion of the groundwater baseflow contributing to the surface drainage basins of the Humber Valley area is considered to be derived from shallow flow systems within the overburden material. The subsurface residence time of this groundwater is generally of a much shorter duration than that of groundwater encountered by wells completed at depth in the bedrock and correspondingly the concentrations of dissolved constituents in the shallow flow system are lower. When discharged, the shallow groundwater will be mixed with additional dilute baseflow derived from slow release of surface water stored in lakes and bogs plus runoff water. It is considered that the surface water will be most dilute during periods of peak runoff.

It is extremely difficult to determine a chemical mass balance for streamflows that incorporate both groundwater and surface water especially when the amount of data available is very limited. However, the

TABLE 12

SUMMARY OF SURFACE WATER QUALITY

UPPER HUMBER RIVER AND INDIAN BROOK

1965 TO 1980

Sample Location		Upper Humber River Near Reidville			Indian Brook Near Springdale		
		Low	High	Average	Low	High	Average
Cond.	µS	21	95	40	23	63	40
pH		4.6	7.9		5.3	7.8	
Na	mg/l	1.1	7.7	2.7	1.5	4.5	2.4
K	"	.1	.8	.4	<.1	1.4	.3
Ca	"	.9	7.0	3.6	1.6	5.3	3.3
Mg	"	.3	2.1	1.0	.3	1.9	1.3
HCO_3	"	3	52	12	4	23	12
Cl	"	1.5	17.0	4.1	2.5	7.9	3.9
F	"	<.05	<.10	.07	<.02	.11	.07
SO_4	"	1.6	7.8	3.9	1.6	7.8	3.1
NO_3 + NO_2 (as N)	"	<.001	.37	.082	<.001	.18	.061
TDS	"	10	48	21	13	31	20
Fe	"	.020	.170	.100	<.001	.060	.032
Mn	"	<.010	.010	.010	<.001	.010	.010
Zn*	"	<.001	.10	.011	<.001	.016	.004
Cu*	"	<.001	.014	.003	<.001	.017	.004
Cd*	"	<.001	.002	.001	<.001	<.01	.001
Hardness (as $CaCo_3$)	"	3.6	25.9	12.9	7.3	21.1	13.7

* extractable concentrations

relative abundance of the dissolved constituents can be used to infer the general composition of the groundwater that is discharging to the stream course. Chemical data from surface water is considered to be most representative of groundwater during the dry periods of the year when groundwater discharge is largely responsible for maintaining stream flow.

The chemical composition of water collected from both the Upper Humber River and Indian Brook is quite similar as represented on Table 12. The dominant dissolved constituents are sodium, calcium bicarbonate, chloride and to a lesser extent sulphate. These constituents are typical of the regional groundwater composition within the Humber Valley area. However, the surface water is very dilute in comparison to the groundwater. The average total dissolved solids of the surface water in both streams is 20 mg/l; approximately an order of magnitude lower than that of the groundwater. The somewhat higher concentration of sodium and chloride recorded in the Upper Humber River compared to Indian Brook (Table 12) may reflect baseflow contribution from the known occurrences of saline groundwater within the Deer Lake Basin.

7. CONCLUSIONS

The overburden and bedrock strata within the Humber Valley area are capable of supplying low to moderate well yields. Accordingly, wells have been extensively used throughout the populated areas for both domestic and commercial water supplies.

The evaluation of the groundwater resources within the Humber Valley area presented in this report has largely been conducted utilizing information provided by commercial well drillers as recorded on the Department of Environment water well records. The 160 water well records currently available for the Humber Valley area are not considered to be representative of the total number of drilled wells within the area. Furthermore, much of the data provided on the records is incomplete, however, it is to be hoped that with increased familiarity with the data requirements for well records; improvements in the quality of the data provided by well drillers will occur. In this regard, it should also be noted that many of the wells within the Humber Valley area are of the shallow dug variety for which no records are required.

Based on the available data, it is inferred that the overburden deposits of sand and gravel located within the Humber Valley area are capable of supplying substantial volumes of groundwater in the order of 100 ℓ/min (22 gpm). A semi-confined gravel aquifer encountered by a well located at the Deer Lake Airport has produced 545 ℓ/min (120 gpm) and is considered to be capable of safely producing up to 900 ℓ/min (200 gpm). The potential thus exists for locating other similar semi-confined aquifers associated with buried gravel deposits elsewhere in both the Upper Humber River Valley and the Exploits River - Red Indian Lake Valley. By contrast, the glacial till deposits that are located throughout much of the study area appear to be only capable of limited yields based on data from shallow dug wells utilized for domestic water supplies.

The bedrock strata underlying the study area have a broad range of well yields. In general, the granitic rocks and high grade metamorphic strata are considered to provide low well yields in the range of <1 to

9.1 ℓ/min (< .2 to 2 gpm). The highest bedrock well yields are considered to be associated with the limestone and dolostone strata of the St. George's group where well yields of 14 to 159 ℓ/min (3 to 35 gpm) have been recorded. The well records indicate that the other sedimentary and volcanic strata underlying the study area are capable of producing a broad range of well yields from 0 to 455 ℓ/min (0 to 100 gpm) with average yields of 22 to 36 ℓ/min (4.8 to 7.9 gpm), respectively.

Due to the fracture controlled nature of groundwater movement in rock, it is very difficult to accurately specify the potential well yields of the strata within the area. However, the use of proper hydrogeological exploration methods can enhance the potential success of well drilling. In a very broad sense, the potential of the bedrock to yield sufficient water to drilled wells for individual domestic purposes is considered to be fair to good for most of the inhabited regions of the study area. Based on experience in the Notre Dame Bay area, potential also exists for the increased use of communal well supplies.

Groundwater quality data within the Humber Valley area is limited to a few records of communal well water supplies and groundwater quality investigations carried out in the community of Cormack and in Gros Morne National Park. This chemical data is generally not representative of the full suite of dissolved constituents that commonly occur in groundwater and where complete, such as for the Cormack area, the data often contains large analytical errors as indicated by the ionic charge balances. Analytical errors can be largely eliminated through proper groundwater sampling techniques and improved quality control by the analytical laboratories used.

Groundwater quality within the Humber Valley tends to be a calcium to calcium magnesium bicarbonate water that locally varies from soft to hard. Concentrations of iron and manganese are locally encountered. Soft water can be anticipated from the granitic terrain whereas hard water can be anticipated from the sedimentary strata containing limestone and dolostones. The groundwater from most areas within the

Humber Valley where wells have been propoerly installed is considered to be of moderately high quality for potable water supply purposes.

Localized areas of saline, sulphurous groundwater occur within specific areas of the Humber Valley that are underlain by sedimentary strata of the Carboniferous age Deer Lake Group. These areas notably occur in the vicinity of Cormack where wells have encountered non-potable saline groundwater. These occurrences of saline groundwater have been identified on a reconnaissance scale only. From the available data, the source of the salinity in the groundwater is attributed to the underlying rock strata. Additional well sampling programs within the areas underlain by strata of the Deer Lake Group are required to outline the full extent and nature of these saline groundwater occurrences.

The quality of surface water within the study area has been monitored in the Upper Humber River near Reidville and in Indian Brook near Springdale. The water in these streams is very soft in nature. The dissolved constituents within it tend to reflect those that occur in the regional groundwater which supplies baseflow to the drainage basin. However, the concentration of the dissolved constituents in the surface water are an order of magnitude more dilute than that of the groundwater.

Bacterial contamination is considered to be the primary potential threat to domestic well water sources within the study area. This threat increases as the population of communities that are dependent on wells increases or where domestic livestock are held. The threat of bacterial contamination in well water can be largely eliminated by the use of properly located and constructed drilled wells. Such measures include installation of properly seated well casings set at least 3 m into the bedrock surface and the use of sanitary well seals to prevent infiltration of surface water into the wells.

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APPENDIX I

CENSUS DATA
HUMBER VALLEY STUDY AREA
NEWFOUNDLAND

POPULATION STATISTICS

HUMBER VALLEY STUDY AREA

BAIE VERTE - WHITE BAY DISTRICT

COMMUNITY	CENSUS YEAR			COMMUNITY STATUS	
	1966	1971	1976	INCORPORATED	UNINCORPORATED
Baie Verte	2144*	2397	2528	✓	
Brents Cove	291*	359	379	✓	
Burlington	325	363	381	✓	
Coachman's Cove	317	334*	293	✓	
Fleur de Lys	609	672*	694	✓	
Harbour Round	233	275	286		✓
La Scie	1064	1255	1256	✓	
Middle Arm	442	474*	555	✓	
Ming's Bight	371	378*	412	✓	
Nippers Harbour	290*	275	260	✓	
Pacquet	385*	429	427	✓	
Purbecks Cove	83	73	90		✓
Round Harbour	93	60	56		✓
Seal Cove	561	698	774	✓	
Shoe Cove	190	211	232		✓
Smiths Harbour, Stocking Harbour	189	56	190		✓
Snooks Arm	94	99	60		✓
Tilt Cove	436	87*	69	✓	
Westport	379	416*	464	✓	
Wild Cove	176	172	158		✓
Woodstock	224	288*	334	✓	
	8896	9371	9898		

NOTES: * denotes change in boundary due to annexation or incorporation

POPULATION STATISTICS

HUMBER VALLEY STUDY AREA

BAY OF ISLAND DISTRICT

COMMUNITY	CENSUS YEAR			COMMUNITY STATUS	
	1966	1971	1976	INCORPORATED	UNINCORPORATED
Benoit's Cove	804	1177	1262		✓
Corner Brook[(1)]	27116	26309	25198	✓	
Cox's Cove	208	797*	1004	✓	
Frenchmans Cove	192	275	321		✓
Gillams	358	363	491*	✓	
Lark Harbour	349	590	771*	✓	
McIvers	550	656	389*	✓	
Mount Moriah	668	635	703*	✓	
Summerside	547	603*	830	✓	
York Harbour	205	264	330*		
	30997	31669	31299		

NOTES: * denotes change in boundary due to annexation or incorporation

(1) includes Corner Brook East, Corner Brook West, Curling and Georgetown

POPULATION STATISTICS

HUMBER VALLEY STUDY AREA

HUMBER VALLEY DISTRICT

COMMUNITY	CENSUS YEAR			COMMUNITY STATUS	
	1966	1971	1976	INCORPORATED	UNINCORPORATED
Cormack	432*	561*	672	✓	
Deer Lake	4209	4421	4546	✓	
Dogwood			81		✓
George's Cove	4	15	23		✓
Hampden	733	739	780	✓	
Howden	395	409	404	✓	
Jackson's Arm	450	491	482		✓
Little Harbour	12	33	14		✓
Little Rapids	177	208	208		✓
Nicholsville	225	236	301		✓
Pasadena	685	964*	1850	✓	
Pynns Brook	69	78	83		✓
Reidville	240	248	358*	✓	
Sops Arms		382	376		✓
South Brook	743	802*	828		✓
St. Judes, Lake Siding	309	324	325		✓
Steady Brook	216	288	292	✓	
The Beaches	128	130	149		
	9027	10329	11772		

NOTES: * denotes change in boundary due to annexation or incorporation

POPULATION STATISTICS

HUMBER VALLEY STUDY AREA

HUMBER - ST. BARBE

COMMUNITY	CENSUS YEAR 1966	1971	1976	COMMUNITY STATUS INCORPORATED	UNINCORPORATED
Birchy Head	144	118	140		✓
Glenburnie	159	159	156		✓
Lomond	65		8		✓
Norris Point	885*	986	1065	✓	
Rocky Harbour	961*	982	1267	✓	
Shoal Brook	201	150	147		✓
Trout River	655*	689	784	✓	
Wiltondale	94	29	30		✓
Woody Point (includes Bonne Bay, and Curzoh)	506	500*	529*		
	3670	3613	4126		

NOTES: * denotes change in boundary due to annexation or incorporation

POPULATION STATISTICS

HUMBER VALLEY STUDY AREA

GREEN BAY DISTRICT

COMMUNITY	CENSUS YEAR 1966	1971	1976	COMMUNITY STATUS INCORPORATED	UNINCORPORATED
Kings Point	561	651*	770	✓	
Rattling Brook	188	172	176		✓
South Brook	743	802*	828	✓	
	1492	1625	1774		

WINDSOR - BUCHANS DISTRICT

COMMUNITY	CENSUS YEAR 1966	1971	1976	COMMUNITY STATUS INCORPORATED	UNINCORPORATED
Buchans (2)	2543	2357	2078	✓	
Buchans Junction	272	300	269		✓
Millertown	355	316	273		✓
Millertown Junction	119	69	35		✓
	3289	3042	2655		

TOTAL POPULATION - HUMBER VALLEY AREA	57371	59649	61524

NOTES: * denotes change in boundary due to annexation or incorporation

(2) includes incorporated community of Buchans plus Buchans Company community.

APPENDIX II

WATER WELL DATA
HUMBER VALLEY STUDY AREA
NEWFOUNDLAND

BAIE VERTE - WHITE BAY DISTRICT

COMMUNITY	WELL NO. AND OWNER	DATE MO/YR	DEPTH ft	WATER FOUND ft	CASING		YIELD gpm	KIND OF WATER	WATER USE	LITHOLOGY
					LENGTH ft	DIAMETER in.				
Baie Verte	1 Shepherd	75/	224				4	FR	CO	0-12 overburden 12-224 Sticky Asbestos Type Bedrock
"	2 Wood Workers		233		6	6		FR	IN	0-6 overburden 6-233 Bedrock
"	3	62/9	73					FR	DO	0-50 Sand & Gravel 50-73 Bedrock
"	4 Nfld.Power Co. Ltd.	73/5	113		7	6	1/2	FR	CO	0-6 overburden 6-113 Bedrock
"	5 CIL	71/12	200		39		2	FR	IN	
"	6 D.O.P.W.	74/	180		8	6	4	FR	MU	0-8 overburden 8-172 Bedrock
Rambler Mines	1 Rambler Mines	77/12	200		19	6	.25			0-15 gravel & broken rock 15-200 bedrock
"	2 Rambler Mines	77/12	145	100	22	6	1			0-14 gravel & broken rock 14-145 Bedrock
"	3 Rambler Mines	77/12	85	40	22	6	20			0-18 gravel 18-85 Bedrock
"	4 School Board	77/12	250	125	31	6	4			0-28 gravel & boulders 28-250 Bedrock
Brent's Cove	1	67/8	130				20	FR	DO	0-6 overburden 6-130 Bedrock
"	2 Comm. Council	67/10	120			6	20	FR	MU	0-5 overburden 5-120 Bedrock
"	3	67/10	70				6	FR	DO	0-4 overburden 4-70 Bedrock
"	4	67/11	102				12	FR	DO	0-9 overburden 9-102 Bedrock
"	5	68/11	78			6	4	FR	MU	0-6 overburden 6-78 Bedrock
"	6	68/10	63				5	FR	DO	0-6 overburden 6-63 Bedrock
"	7 J.Fury		203		13	6	60	FR	CO	0-13 overburden 13-203 Bedrock
"	E.Drover	80/3	50	43	11	6	2		DO	0-5 gravel 5-50 Bedrock
"	G. Haar	79/8	105	42	12	6	3		DO	0-10 gravel 10-105 Bedrock
"	P. Haar	79/8	45	38	10	6	9		DO	0-7 gravel 7-45 Bedrock
"	V. Haar	79/8	85	70	12	6	7		DO	0-10 gravel & boulders 10-85 Bedrock
"	M.Sullivan	79/8	65	62	19	6	40		DO	0-15 gravel & boulders 15-65 Bedrock
"	G.Matthews	79/8	100	90	10	6	100		DO	0-6 gravel 6-100 Bedrock
"	S. Drover	79/8	85	30	9	6	1 1/2		DO	0-6 gravel & rock 6-85 Bedrock

BAIE VERTE-WHITE BAY DISTRICT (continued)

COMMUNITY	WELL NO. AND OWNER	DATE MO/YR	DEPTH ft	WATER FOUND ft	CASING LENGTH ft	CASING DIAMETER in.	YIELD gpm	KIND OF WATER	WATER USE	LITHOLOGY
Smith's Hr.	1 Comm.	74/9	105		10	6		Bact. Un-sats.		0-10 overburden 10-105 Bedrock
"	2 D.M.A.H.	74/9	105		16	6		"		0-16 overburden 16-105 Bedrock
"	3 D.M.A.H.	74/9	115		5	6		"		0-5 overburden 5-115 Bedrock
"	4 D.M.A.H.	74/9	305		6	6		"	MU	0-6 overburden 6-305 Bedrock
"	Noonan	78/9	100	30	10½	6	1/2		DO	0-2 gravel 2-100 Bedrock
"	School	78/9	200	88	10	6	1/2			0-1 topsoil 1-200 Bedrock
Westport		79/4	210	150	9	6	1/2		DO	0-2 gravel 2-210 Bedrock

BAY OF ISLAND DISTRICT

Benoit's Cove	1 J. Gash	80/6	237			6		FR	DO	
"	2 D.McCarthy R. Young	80/6	124	40 89 118	35	6		FR	DO	0-124 Bedrock
"	3 Nfld. Telephone Co.	80/10	144	30 73 127	18	6	< .6	FR	CO	0-4 Peat, Broken rock 4-10 Black Shale 10-23 Brown conglom-erate 23-144 Black shale
"	4 R. Jesso	80/10	84	28 53 78	17	6	< 1	FR	DO	0-9 Sand & gravel 9-84 Black shale
"	1	65/12	237		12			FR	DO	0-12 Gravel & Boulders 12-237 Bedrock
"	2	65/12	33							
Cox's Cove	1 Campbell Eng.	74/4	143		33	6	12	FR	IN	0-33 overburden 33-143 Bedrock
"	2 Island Engineering Company	80/4	330	51 76 124 135	23	6	17	FR	MU	0-6 Brown Fill 6-14 Brown Fill 14-84 Limestone 84-231 Shale, Calcite 231-235 Calcite, shale 235-330 Dark grey shale Calcite
Gilliams	Comm. of Gilliams	81/6	42	40	40	6 1/8	70.6	FR	DO	0-42 Sand & gravel
"	1 Brahes Constr.	75/	200				6	FR	CO	0-14.6 overburden 14.6-200 Bedrock
"	2 Comm. Coun.	75/	250		14		NIL		CO	0-14 overburden 14-250 Bedrock
John's Beach	1 S. Childs	75/	260				1	FR	COM	0-20 overburden 20-260 Bedrock
Lark Harbour	1 Nat'l Sea Products	75/	300				1	FR	IN	0-50 overburden 50-300 Bedrock
"	2 "	76/	100		44	6 1/8	2	FR	IN	0-44 Sandy soil 44-100 Bedrock

BAY OF ISLAND DISTRICT (continued)

COMMUNITY	WELL NO. AND OWNER	DATE MO/YR	DEPTH ft	WATER FOUND ft	CASING		YIELD gpm	KIND OF WATER	WATER USE	LITHOLOGY
					LENGTH ft	DIAMETER in.				
Meadows	1 D.M.A.H.	75/	200			6 1/8	5	FR	MU	0-10 overburden 10-200 Bedrock
"	2 D.M.A.H.	75/	150		40	6 1/8		FR	MU	0-40 overburden 40-150 Bedrock
"	3 D.M.A.H.	75/	150		21	6 1/8		FR	MU	0-20 overburden 20-150 Bedrock
"	4 D.M.A.H.	75/	150		17 1/2	6 1/8	8	FR	MU	0-10 overburden 10-150 Bedrock
"	5 D.M.A.H.	75/	150		13	6 1/8	4	FR	MU	0-13 overburden 13-150 Bedrock
"	6 D.M.A.H.	75/	260		19	6 1/8				0-10 overburden 10-260 Bedrock
"	7 H. Flander	76/	90			6 1/8	32	FR	DO	0-19 overburden 19-90 Bedrock
"	8 B. Green	75/7	160					FR	DO	0-9 overburden 9-160 Bedrock
"	9	67/9	140		30		30	FR	DO	0-30 gravel 30-140 Bedrock
"	10 A. Ellsworth		120				6	FR	DO	0-11 overburden 11-120 Bedrock
McIvers	1 Comm. Council	75/	260				9	FR	MU	0-10 overburden 10-260 Bedrock
"	2 C. Pittman	75/	220			6 1/8		FR	DO	
Mt. Moriah	1 Mt.Moriah		53		11	6	6	FR	MU	0-11 overburden 11-53 Bedrock
"	2 "		128		25	6	4	FR	MU	0-25 overburden 25-128 Bedrock
"	3 "		158		22	6	4	FR	MU	0-22 overburden 22-158 Bedrock
"	4 "		98		22	6	5	FR	MU	0-22 overburden 22-98 Bedrock
"	5 "		83		10	6	8	FR	MU	0-10 overburden 10-83 Bedrock
Petries	British American Oil Ltd.	65/9	202		59					0-59 overburden 59-202 Bedrock
Pinch Gut Lake	1 Golden Eagle		368		13 1/2	6	3	FR	CO	0-13 overburden 13-368 Bedrock
Summerside	1 B. Hann	76/	100		15	6 1/8	12		DO	0-15 overburden 15-100 Bedrock
Unknown	1 St.George Sch.Board	75/	185				30			0-62 overburden 62-185 Bedrock

GREEN BAY DISTRICT

Baie Verte Junction	1 Irving Oil Co.		158		43	6	7-8			0-43 overburden 43-158 Bedrock
"	2 "	71/12	215		18	6	2			0-18 overburden 18-215 Bedrock
"	3 Golden Eagle	66/12	95		30	6				0-30 sand 30-95 Bedrock
"	4 Indian River Motel	70/9	188		36		12		DO	0-36 overburden 36-188 Bedrock

HUMBER VALLEY DISTRICT (continued)

COMMUNITY	WELL NO. AND OWNER	DATE MO/YR	DEPTH ft	WATER FOUND ft	CASING		YIELD gpm	KIND OF WATER	WATER USE	LITHOLOGY
					LENGTH ft	DIAMETER in.				
St. Judes		77/12	200	125	50		1 1/2		Mu	0-12 sand & gravel 12-200 Bedrock
"	C.Mynes	80/4	48	27	48	6	.1	FR	DO	0-37 Brown coarse sand 37-48 sand & gravel
George's Lake	C. Wells	80/7	204	195	26	6	.8	FR	DO	0-22 fractured grey shale 22-138 black shale 138-204 grey & black shale
Hampden	1 School	75/7	595		66		4			
"	2 School		140		66					
"	3 School		255				3/4			
"	4 School	75/7	200				4			
Pasadena	1 School	70/11	458		127					
"	2	68/5	190				4			
"	3	67/1	120		65	6	6.7			0-65 sand 65-120 Bedrock
"	4 N.Bennett	55/	50			1 1/4				
"	5 W.Lundrigan	77/5	204	96	83 1/2	16	2		DO	0-62 sand 62-204 Bedrock
"	6 J.Knight	80/8	280	192 260	45		< .5			0-2 Brown fill 2-20 weather sandstone and shale 20-280 red, brown & green sandstone
"	7 H.Squires	78/7	200		66					0-60 overburden 60-200 Bedrock mudstone
Flynn's Brook	1 D.O.F.		38		22	6				
"	2 D.O.F.		50		22	6				
"	3 D.O.F.		155		22	6	3-4			
"	4 B.Bussey	78/6	430		43	6	.06		DO	0-38 sand & gravel 38-430 shale
Heidville	J.Laden	80/8	168	50 145 166	162	6	< 10	Fk	DO	0-158 sand & gravel 158-168 Bedrock grey shale
Sops Arm	1 School	75/6	395		9		1/2			
Watson's Pond Corner Brook	Day & Ross Ltd.	80/7	104	102	34.3	6	3	FR	CO	0-26 glacial till 26-80 slate & limestone 80-104 limestone & sandstone
"	Sand Kath Enterprise	81/6	124	87 115	44	6	23	FR	In	0-40 gravel & clay silt 40-124 limestone
Hammond Farm	1		128			6				

BAIE VERTE - WHITE BAY DISTRICT (continued)

COMMUNITY	WELL NO. AND OWNER	DATE MO/YR	DEPTH ft	WATER FOUND ft	CASING LENGTH ft	CASING DIAMETER in.	YIELD gpm	KIND OF WATER	WATER USE	LITHOLOGY
Brent's Cove	K. Haas	79/8	45	25	13	6	30		DO	0-10 gravel 10-45 Bedrock
Fleur de Leys	1 R.C. School Brd.	74/7	218		8	6	2	FR	MU	0-8 overburden 8-218 Bedrock
"	2	68/9	158			6	4	FR	DO	0-6 overburden 6-158 Bedrock
Harbour Hound	1 Comm. Council	71/6	203		8	6	7	FR Hard Water, Slight Brown Colour	MU	0-8 overburden 8-203 Bedrock
"	2 Comm. Council	71/6	113		7	6	2	FR	MU	0-7 overburden 7-113 Bedrock
"	3 D.M.A.H.		205				3	FR Poor Quality	DO	
"	4 D.M.A.H.		105				4	FR Poor Quality	DO	
Middle Arm	1 Comm. Council	68/8	100				12	FR	MU	0-6 overburden 6-100 Bedrock
Nipper's Hr.	1	68/2	287				2	FR	DO	0-11 overburden 11-287 Bedrock
"	2	68/4	236				2-3	FR	DO	0-9 overburden 9-236 Bedrock
Pacquet	1 J.Sacrey	76/9	95			6	1/2	FR	DO	0-6 overburden 6-95 Bedrock
"	Pentecostal Assem.	77/10	100	90	24	6	12		DO	0-20 gravel & broken rock 20-100 Bedrock
"	C.Sacrey	77/10	75	59	27	6	3/4		DO	0-24 gravel & broken rock 24-75 Bedrock
"	M. Norman	77/10	145	142	5	6	1/2		DO	0-2 gravel 2-145 Bedrock
"	E. Elliot	77/10	125		8	6	1/16		DO	0-6 gravel & broker rock 6-125 Bedrock
"	R. Burton	79/5	100	50	45	6	1 1/2		DO	0-40 sand & boulders 40-100 Bedrock
"	J. Sacrey	79/5	100	45	7	6	1/4		DO	0-2 gravel 2-100 Bedrock
Shoe Cove	2 C. Gray	80/2	100	98	8	6	1/2		DO	0-3 gravel 3-100 Bedrock
	1 Comm.							Fr., High Color, Low pH Excess of Mn	DO	

GREEN BAY DISTRICT (continued)

COMMUNITY	WELL NO. AND OWNER	DATE MO/YR	DEPTH ft	WATER FOUND ft	CASING		YIELD gpm	KIND OF WATER	WATER USE	LITHOLOGY
					LENGTH ft	DIAMETER in.				
Baie Verte Junction	1 Economic Division	79/5	140	140	27		.5		DO	0-25 sand & gravel 25-140 Bedrock
Kona Beach	1 T.Hewletty	73/8	38		38					0-27 gravel 27-38 sand
Rattling Brook	1 C. Anstey	76/9	96		12		20			0-12 overburden 12-96 Bedrock
South Brook	1 F. Woodworth	75/10	32		32	6	15		DO	0-32 overburden

HUMBER VALLEY DISTRICT

Big Bonne Bay Pond	1 M. Kawaja	77/7	110	57	10	6	7		DO	0-7 gravel 7-110 Bedrock
Wild Cove Park Corner Brook	1 City of Corner Brook	72/5					35			
Cormack	1 R.Woodford	76/	140		15	6 1/8	2		DO	0-15 overburden 15-140 Bedrock
"	2 C.White	76/	140		20	6 1/8	15		DO	0-20 overburden 20-140 Bedrock
"	3 I.Ells-worth	76/	140		20	6 1/8	1 1/2		DO	0-20 overburden 20-140 Bedrock
"	4 Western	72/7	290		54					
"	5 W. Pinsent	75/	120				2.5			0-22 overburden 22-120 Bedrock
"	6 P.Pederson	76/10	60				11			0-15 overburden 15-60 Bedrock
"	7 A. Sutton	76/	44				20			0-20.6 overburden 20.6-44 Bedrock
"	8 P.Manuel		84				4			0-17 overburden 17-84 Bedrock
"	9 W.Benoit	75/	100		21	6 1/8	4			0-20 overburden 20-100 Bedrock
"	H.Squires	78/11	65	41	22	6			DO	0-15 gravel 15-65 Bedrock
"	S.Welsh	78/5	150	125	44	6	1/4		DO	0-25 gravel & broken rock 25-150 Bedrock
"	Crocker Farms	80/5	164	73 96 123 149	42	6	12	FR	DO	0-4 red soil 4-44 sand & gravel 44-164 sandstone & black shale
Deer Lake	1 D.O.T.	66/11	95		93 1/2	6				0-95 sand
"	2 E.P.A.	66/	175	175		6	1/2			
"	3 R. James	75/11	120				5			0-77 sand & gravel 77-120 Bedrock
"	4 Wells & Park Cons.	80/5	264		91	6				0-91 red sand & gravel 91-264 Brown shale
"	5 K.Young	79/3	190		8	6				0-1 broken rock 1-190 Bedrock
"	6 J.Gilles	81/6	120	84	79.3	6		FR	DO	0-4 Red topsoil mud 4-72 Red fine sand 72-120 Grey shale

HUNBER-ST. BARBE DISTRICT

COMMUNITY	WELL NO. AND OWNER	DATE MO/YR	DEPTH ft	WATER FOUND ft	CASING LENGTH ft	CASING DIAMETER in.	YIELD gpm	KIND OF WATER	WATER USE	LITHOLOGY
Lobster Cove Head	1	67/7	58		10	6				0-10 overburden 10-58 Bedrock
Rocky Harbour	1 Nat'l Park	75/	200		52	6 1/8			DO	0-50 black shale & slate 50-200 Bedrock
"	2 Fisheries	74/4	203		10				IN	0-10 overburden 10-203 Bedrock
"	3 Nat'l Park	75/12	200		39	6 1/8	2		DO	0-40 black shale & slate 40-200 Bedrock
"	4 Eagle Ent.	70/10	113		18		3		IN	0-18 overburden 18-113 Bedrock
"	5 Ind.Affairs	71/6	308		8				MU	0-8 overburden 8-308 Bedrock
Trout River	1 Prov. Planning		14						OBV WELL	
"	2 "		14.5						OBV WELL	
"	3 "		22						OBV WELL	
"	4 F. Crocker	74/6	28		28	6		SA	DO	
"	Job Bros.	80/9			22	1.8			OBV Well	
"	Job Bros.	80/9			20	1.8			OBV WELL	
"	Job Bros.	80/9							OBV WELL	

WINDSOR-BUCHANS DISTRICT

Badger	1 J.Coleman	61/9	29							
"	2 R.Poush	61/10	46							
"	3 M.Beresford	73/7	40		40	6	10			0-40 overburden
"	4 School	65/3	103							0-32 overburden 32-103 Bedrock
Buchans Junction	1 D.M.A.H.	75/6	51				5			0-51 overburden
"	2		341			6	1			
"	3 D.M.A.H.	73/1	338		46	6	2			0-46 overburden 46-338 Bedrock
"	4 Water	73/1	50		50	6	8			0-50 overburden
"	5 T.Hewletty		50		36	6	2-3			0-36 overburden 36-50 Bedrock
Millertown	1 Price Nfd	70/8	353		23.5	6	7			0-23 overburden 23-353 Bedrock
"	2 "	69/6	174		86		20		IN	0-86 overburden 86-174 Bedrock
"	3 "	70/3	68		26	6	2			0-25 overburden 25-68 Bedrock
"	4 Nfld.Power	73/10	68		32	6	15			0-32 overburden 32-68 Bedrock
Roebuck Camp	5 Price Nfld.	70/3	170			6	6			0-21 overburden 21-170 Bedrock

30' 15' 58°00'W 45' 30' 15'

50°00'N

45'

STRAIT OF BELLE ISLE

HARE BAY

WHITE BAY

BONNE BAY

BAY OF ISLANDS

NOTRE DAME BAY

FOGO

GANDER

BONAVISTA BAY

GRAND FALLS

STEPHENVILLE

ATLANTIC OCEAN

TRINITY BAY

CONCEPTION BAY

ST. JOHN'S

GRAND BANK

PLACENTIA BAY

SCALE 0 20 40 60 80 100 KILOMETRES

Portland Creek Pond

Inner Pond

Parson's Pond

Parsons Pond

Shallow Bay

Cow Head

Bellowns Point

Broom Pt

St. Pauls Inlet

Gulls Marsh

Martin Pt

Western Brook Pond

Sally's Cove

GROS MORNE

Green Point

Bakers Brook

Lobster Cove

NATIONAL PARK

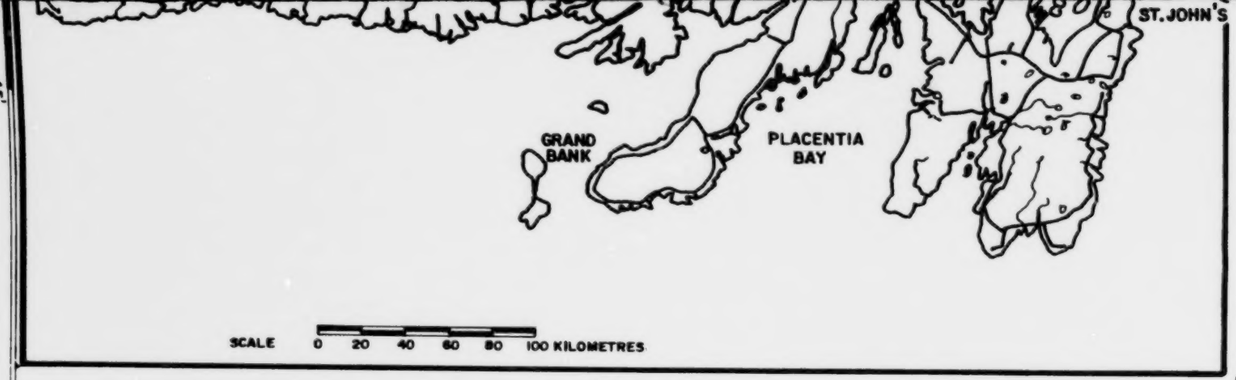
GULF OF ST LAWRENCE

MAPPING NOT AV

45' 30' 15' 57°00'W 45' 30' 15'

Cliffy Point
Portland Creek
Portland Creek Pond
Eastern Head Portland Cove
Portland Creek
Inner Pond
Sandy Bay
Parson's Pond
Parsons Pond
Mountain Pond
Parsons Pond
Parsons Pond
Shallow Bay
Stearing I
Cow Head
Bellowns Point
St Pauls Inlet
Western Brook Pond
GROS MORNE
MAPPING NOT AVAILABLE
ST BARBE SOUTH DISTRICT
WHITE BAY SOUTH DISTRICT
Birchy Head
Muddy Cove
Shoop Point
Little Cat Arm
White Point
Great Cat Arm
Eastern Head
Western Head
WHITE BAY
Big Head
Dead Cove
Cobbler Hd
Coney Head
Great Coney Arm
Frenchman's Hd
Virgin Pt
Open Head
Sops Island
Sops Arm
Shale Pt
Granby I
Spear Pt
Hunter Cove
Wild Cove Pt
Westport
Little Labour Man
Green Point
Big Head
Seal Cove
Fish Pt
Pigeon I
MAPPING NOT AVAILABLE

45'
30'
15'
56°00'W
45'
30'
50°00'N
45'
6
WHITE BAY
ISLANDS
Partridge Point
Barry's Cove Point
Barry's Cove
Cape Crapaud
Fleur de Lys Hbr
Pigeon I
Green Point
Couchman's Harbour
Little Lobster Hbr
Green Point
Point Rouge
Grappling Point
Cape Hat
Cape Corbin
Bees I
Cape St Martin
Facquet
Facquet Hbr
Cape Brulé
Cape Cairs
Cape Cagnet
Confusion Bay
Long Pt
Brant Cove Hd
Cape St John
Redans Pt
Middle Bill
South Bill
Ragged Pt
Manful Hd
Gunning Pt
Bishop's Rock
Bluff Hd
Fishing Pt
Great Caplin Cove
Beaver Cove Hd
Mine (abandoned)
Tilt Cove
Scrape Pt
Round Harbour
Pigeon I
Lower Bill
Mouse Pt
Noble Hd
Nippers Islands
Green Hd
Flour Cask Hd
Stocking Hbr
Burnt I
Ring I
Young Hd
Green Bay I
Green Bay
Western Hd
Hennessey Islands
Little Bay Hd
North Bill
South Bill
Gull Rocks
Middle Is
Crab I
Red Island
Red I
Burnt Hd
Northern Hd
Harbour I
Venison Pt
Fox Neck
Little Bay Island
Hacks I
Iron Pt
Cooper I
Fox Is
Beaver Cove Hd
Halls Bay Hd
Red Fishing Pt
Bob Pt
Otter
Otter I
Western Hd
Beaumont
Giles I
Seal
Burnt Hd
Southern Head
Great Cow Arm
Little Cow Arm
Shoby Head
Muddy Cove
Shoby Point
White Point
Eastern Head
Western Head
Big Head
Dead Cow
Cobbler Hd
Coney Head
Great Coney Arm
Frenchman's Hd
Jacks Cove
Virgin Pt
Pigeon I
Wild Cove Pt
Open Head
Sops Island
Sops Arm
Granby I
Shale Pt
Spear Pt
Schooner Cove
Westport
Western Arm
Seal Cove
Big Head
Fish Pt
Middle Arm
Southwest Arm
Baie Verte
Mine's Bight
Ming's Bight
Seal Cove
Fish Pt
Pigeon I
Wild Cove Pt
Western Arm
Westport
Sops Arm
Shale Pt
Granby I
Spear Pt
Schooner Cove
Middle Arm
Southwest Arm
Wild
Bon
Rattling Pt
MAPPING NOT AVAILABLE
WF XF
WE XE



BASE MAP COMPILED FROM PORTIONS OF NATIONAL TOPOGRAPHIC SURVEY MAPS 2E, 12A, 12B, 12G, 12H AND 12I

CONTOUR INTERVAL 100 FEET
Elevations in Feet above Mean Sea Level
North American Datum 1927
Transverse Mercator Projection

MAPPING NOT AV

GULF OF

GROS MORNE NATIONAL PARK

BAY OF ISLANDS

Gulls Marsh
Martin Pt
Western Brook Pond
Sally's Cove
Green Point
Baker's Brook
Berry Hd
Lobster Cove
Rocky Harbour
Salmon Pt
Bonne Bay
Western Hd
Skinner Cove
Norris Point
Woody Harbour
Trout River Bay
Trout River
Big Cove Hd
Cape St George
North Hd
Gregory I
Beverley Hd
Saddle I
Green I
Hen I
Tweed I
Lower Berth Cove
Shivery Pt
Harbour Pt
Crabb Pt
THE VILLAGE
Pearl (Big) Island
Shag Rocks
Buck Hd
Stowbridge Hd
NORTH ARM
Pond Pt
Guernsey Island
North Arm Pt
Barbours Hd
Eagle I
Northern Hd
OLD WOMAN HEAD
Black Hd
Seal Hd
South Hd
Trumpet Cove
White Point
Long
Boom Loop
Lomond
Adies Dam
Pond
Lake Siding
Pinsock
Main
East Arm
North Arm
Pygmy Arm
South Arm
Western Brook Pond
Bonne Bay
Trout River Pond
River
Lake
Falls
Dam
Mt
Hill
Pt
Hd
I
Cove
Loop
Ferry
Trail
Camp
Ground
Tower
Cabin
Spring
Mine
Quarry
Church
School
Cemetery
Bridge
Ford
Wharf
Boat Launch
Campground
Picnic Area
Lookout
Trailhead
Parking
Visitor Centre
Interpretive Trail
Backcountry Campsite
Backcountry Hut
Backcountry Trail
Boundary
Road
Secondary Road
Unimproved Road
Trail
Power Line
Contour
Index Contour
Spot Elevation
Benchmark
Triangulation Station
Building
Ruins
Lighthouse
Radio Tower
Airport
Helipad
Helicopter Landing Site
Seaplane Base
Boat Launch
Ferry
Ferry Terminal
Marina
Anchorage
Buoy
Beacon
Light
Fog Signal
Radio Beacon
Radio Direction Finder
Radio Station
Radio Tower
Radio Antenna
Radio Repeater
Radio Transmitter
Radio Receiver
Radio Frequency
Radio Channel
Radio Call Sign
Radio Operator
Radio Log
Radio Schedule
Radio Procedure
Radio Phraseology
Radio Emergency
Radio Distress
Radio Urgency
Radio Safety
Radio Navigation
Radio Aid
Radio Facility
Radio Service
Radio Station
Radio Tower
Radio Antenna
Radio Repeater
Radio Transmitter
Radio Receiver
Radio Frequency
Radio Channel
Radio Call Sign
Radio Operator
Radio Log
Radio Schedule
Radio Procedure
Radio Phraseology
Radio Emergency
Radio Distress
Radio Urgency
Radio Safety
Radio Navigation
Radio Aid
Radio Facility
Radio Service
45'
30'
15'
9
8
7
6
5

MAPPING NOT AVAILABLE

MAPPING NOT AVAILABLE

SANDY

LAKE

MAPPING NOT AVAILABLE

SURFICIAL GEOLOGY

PEAT	HIGH BOG AND STRING BOG PEAT ACCUMULATIONS OF VARIABLE THICKNESS OVERLYING BEDROCK OR SURFICIAL DEPOSITS.
SAND & GRAVEL	SANDS, GRAVELS AND SILTS, OF GLACIOFLUVIAL, FLUVIAL, LACUSTRINE OR MARINE TERRACE ORIGIN.
TILL	TILL VENEER AND MORAINE DEPOSITS OF VARIABLE THICKNESS OVERLYING BEDROCK, TILLS VARY FROM SILTY SAND TO CLAYEY SILT AND LOCALLY INCLUDE ICE CONTACT SAND AND GRAVEL.
ROCK	EXPOSED BEDROCK PLAINS, KNOBS AND RIDGES, INCLUDES AREAS OF THIN TILL VENEER AND COLLUVIUM

SOURCES OF INFORMATION:

D. R. GRANT, GEOLOGICAL SURVEY OF CANADA, SURFICIAL GEOLOGY 1:50000 MAP SHEETS, NFLD.

D.G. VANDERVEER, NEWFOUNDLAND DEPARTMENT OF MINES AND ENERGY, SURFICIAL GEOLOGY, 1:50000 MAP SHEETS, NFLD.

SURFICIAL DEPOSIT HYDROSTRATIGRAPHIC UNITS

SURFICIAL HYDROSTRATIGRAPHIC UNIT	WELL YIELD, lpm (gpm)			WELL DEPTH, m (feet)			DATA SOURCE
	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	
UNIT A TILL LOW YIELD	0-45.5 (0-10)	9.1 (2)		4.6-45.7 (15-150)			1.
UNIT B SAND AND GRAVEL	4.5-341 (1-75)	100 (22)	45.5 (10)	9.8-15.2 (32-50)	13.1 (43)	13.7 (45)	2.
MODERATE TO HIGH YIELD	5.5-273 (1.2-60)	24.5 (5.4)	22.7 (5)	7.6-27.4 (25-90)	14 (46)		1.

BAY OF ISLANDS

MAPPING NOT AVAILABLE

NEWFOUNDLAND

NORTH ARM MTN

OLD WOMAN HEAD

MURRAY MTNS

TABLE MTN

MOUNT MORIAH

Pearl (Big) Island

Woods Island

Wood's Island

Puffin Islands

Guernsey Island

Governors Island

Shag Rocks

Fish Heads

Shag Island

Corner Brook

Georgetown

Humber Wharves

Meadows

Steadies

Frenchman's Hd

Lark Harbour

Halfway House

Pynns Brook

Nicholsville

Lake Siding

Penstock

Black Lake

Steady Brook

Rapids

Dam

Wharf

Bear Cove

Trumpet Cove

Wild (Capelin) Cove

Little Port Hd

Devil Hd

Tortoise Point

Fleming Pt

White Point

Broad Cove

Broad Cove Pt

Rope Cove

Mine Cove

Long Lake

Serpentine Lake

George Lake

Pinchgut Lake

Deer Lake

Grand Lake

Humber Arm

Middle Arm

Goose Arm

Penguin Arm

North Arm

Sword Pt

Peter Pt

Shoal Pt

Meadow Point

Fox Pt

Giles Pt

Pond Pt

Stowbridge Hd

Buck Hd

Barbours Hd

Northern Hd

Eagle I

Seal I

Black Hd

Woman Pt

Long Pt

Cat's Pt

Middle Arm Pt

Balsam Pt

Gillams Cove

Frenchmans Cove

Lobster Cove

Crabb Pt

Harbour Pt

Shivers Pt

Lower Berth Cove

Saddle I

Green I

Hen I

Tuckamore

Boom Pier

Boom Dam

Penstock

Dam

Wharf

Rapids

Bare

Steady Brook

Lake

Pond

Brook

Cove

Point

Head

Island

Arm

Lake

Mountains

Newfoundland

Bay of Islands

Humber Arm

Deer Lake

Grand Lake

Lake Siding

Nicholsville

Pynns Brook

Corner Brook

Georgetown

Humber Wharves

Steadies

Halfway House

Mount Moriah

Table Mtn

Murray Mtns

North Arm Mtn

Old Woman Head

Lark Harbour

Woods Island

Puffin Islands

Wood's Island

Guernsey Island

Governors Island

Shag Rocks

Fish Heads

Shag Island

Pearl (Big) Island

MAPPING NOT AVAILABLE

MAPPING NOT AVAILABLE

LONG RANGE MOUNTAINS

THE TOPSAILS

THE TOPSAILS

DEER LAKE

GRAND LAKE

SANDY LAKE

Hinds Lake

Buchans Island LAKE

Nicholsville

Lake Siding

Pynns Brook

South Brook

Steady Brook

Hinds Pt.

Hinds L.

Goose Pond

Wolf Pond

Gaff Topsails

Main Topsail

Burnt Hill

Three Corner Pond

Dawes Pond

Buchans Junction

Buchans

Fall Line

Dam

Wharf

Boom piers

Lower Penstock Dam

Upper Penstock Dam

Penstock

Power House

Intake

Canal

Tailrace

Diversion Dam

Spillway

Bridge

Ferry

Trail

Railway

Power Line

Telephone Line

Highway

Road

Lake

Pond

Brook

Creek

Swamp

Rapids

Falls

Cliff

Contour

Index Contour

Bench Mark

Triangulation Station

Spot Elevation

Cemetery

Church

Lighthouse

Mine

Quarry

Pit

Tower

Wharf

Boom piers

Dam

Penstock

Power House

Intake

Canal

Tailrace

Diversion Dam

Spillway

Bridge

Ferry

Trail

Railway

Power Line

Telephone Line

Highway

Road

Lake

Pond

Brook

Creek

Swamp

Rapids

Falls

Cliff

Contour

Index Contour

Bench Mark

Triangulation Station

Spot Elevation

Cemetery

Church

Lighthouse

Mine

Quarry

Pit

Tower

30'

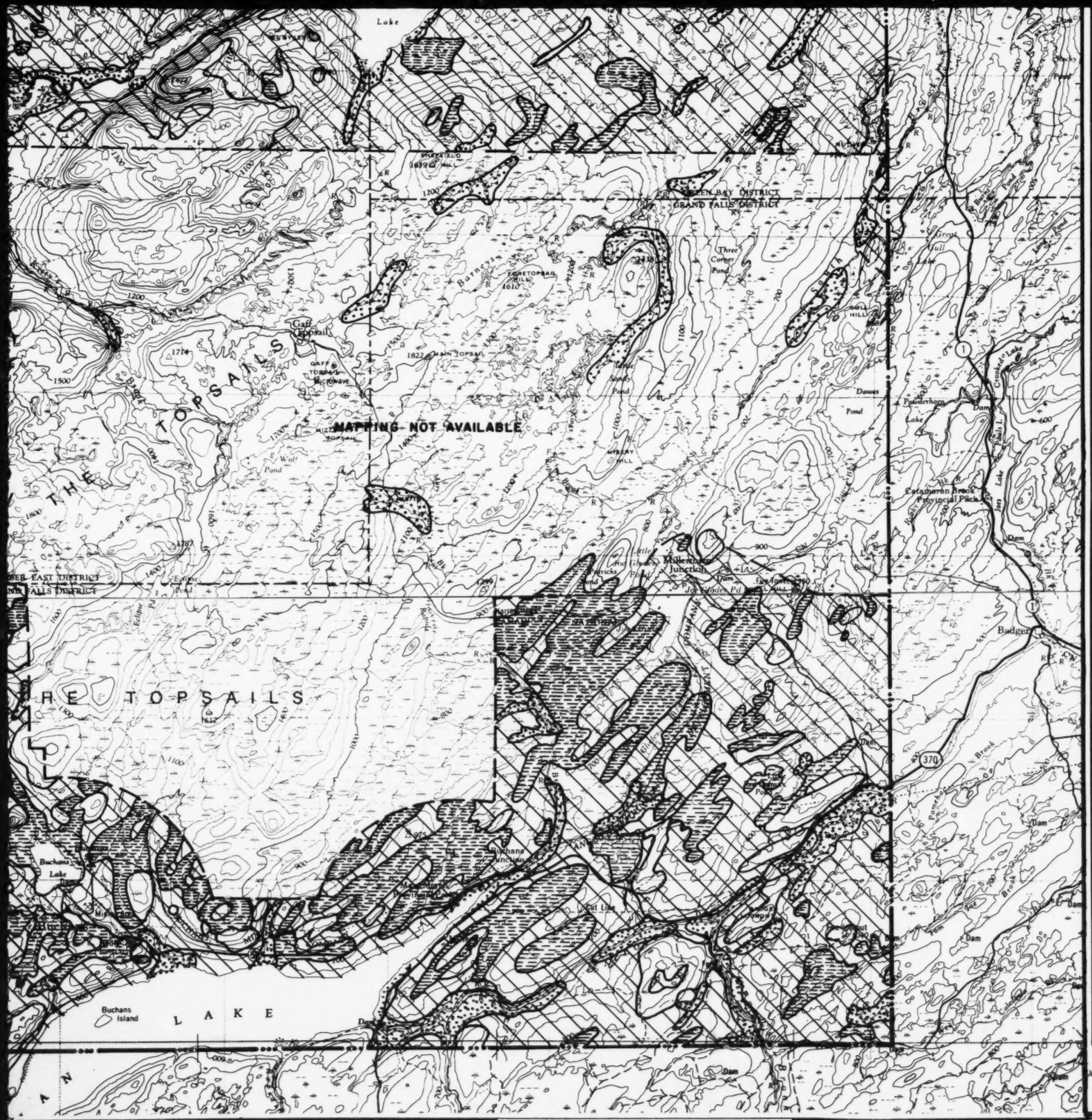
15'

57°00'W

45'

30'

15'



SOURCES OF INFORMATION:

D. R. GRANT, GEOLOGICAL SURVEY OF CANADA, SURFICIAL GEOLOGY 1: 50000 MAP SHEETS, NFLD.

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SURFICIAL DEPOSIT HYDROSTRATIGRAPHIC UNITS

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MODERATE TO HIGH YIELD	5.5-273 (1.2-60)	24.5 (5.4)	22.7 (5)	7.6-27.4 (25-90)	14 (46)		1.

SOURCES OF DATA:

1. HYDROGEOLOGICAL STUDY NOTRE DAME BAY AREA, NFLD. WATER RESOURCES REPORT 2-1, DEPT. OF CONSUMER AFFAIRS AND ENVIRONMENT, PROVINCE OF NEWFOUNDLAND AND LABRADOR.
2. HYDROGEOLOGICAL STUDY HUMBER VALLEY AREA (ACCOMPANYING REPORT TO THIS MAP).

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

MAP No. 1

SURFICIAL GEOLOGY AND HYDROSTRATIGRAPHIC UNITS

HUMBER VALLEY AREA, NEWFOUNDLAND

.Golder Associates

MHW 4/3/85

Scale 1:250,000 Échelle

Miles 5 0 5 10 15 20 Miles

Kilometres 5 0 5 10 15 20 25 30 Kilomètres

30'

15'

58°00'W

45'

30'

50°00'N

45'

STRAIT OF BELLE ISLE

HARE BAY

WHITE BAY

ATLANTIC OCEAN

BONNE BAY

NOTRE DAME BAY

FOGO

BAY OF ISLANDS

GANDER

BONAVISTA BAY

GRAND FALLS

STEPHENVILLE

TRINITY BAY

CONCEPTION BAY

ST. JOHN'S

GRAND BANK

PLACENTIA BAY

SCALE 0 20 40 60 80 100 KILOMETRES

Portland Creek

Portland Creek Pond

Inner Pond

Parson's Pond

Parsons Pond

Shallow Bay

Cow Head

Broom Pt

St Pauls Inlet

Gulls Marsh

Martin Pt

Western Brook Pond

Sally's Cove

GROS MORNE

Green Point

Baker's Brook

Berry Hd

Lobster Cove

GULF OF ST LAWRENCE

45' 30' 15' 57°00'W 45' 30' 15'

Portland Creek

Portland Creek Pond

Inner Pond

Eastern Head Portland Creek

Cliffy Point

Portland Creek Hill

Sandy Bay

Parson's Pond

Parsons Pond

Mowing Pond

PARSONS POND (Ra)

Shallow Bay

Steering I.

Cow Head

Belldowns Point

St Pauls Bay

St Pauls

St Pauls Inlet

Western Brook Pond

GROS MORNE

ST BARBE SOUTH DISTRICT

WHITE BAY SOUTH DISTRICT

Birchy Head

Pumbly Cove

Stump Point

Little Cat Arm

White Point

Great Cat Arm

Eastern Head

Western Head

WHITE BAY

Big Head

Devil Cove

Coppler Hd

Coney Head

Frenchman's Hd

Jacksonia

Virgin Pt

Wild Cove Pt

Open Head Channel

Sops Island

Sops Arm

Spear Pt

Granby I.

Shale Pt

Westport

Western Arm

Little Lobster Hbr

Green Point

Big Head

Seal Cove

Fish Pt

Pigeon I.

Cape Ea

CF

OSV

SC

PC

55

6

45' 30' 15' 56°00'W 45' 30'

50°00'N

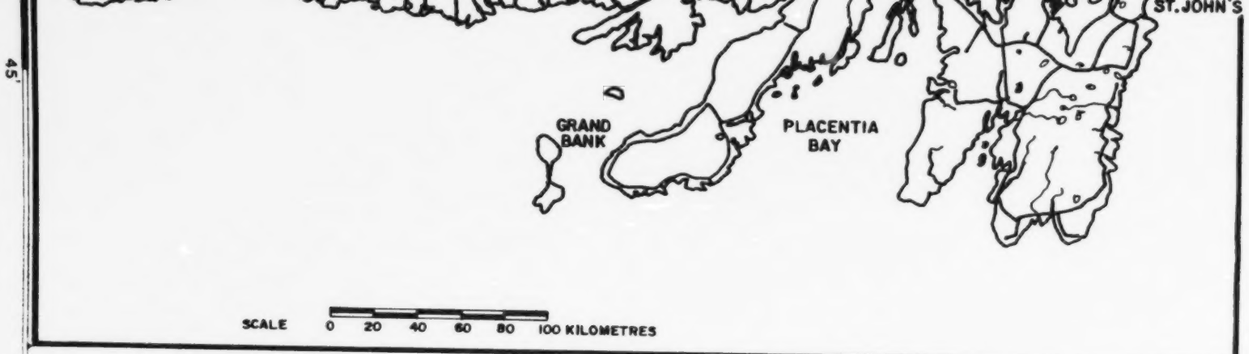
45

6

WHITE BAY

ISLANDS

Partridge Point
Berry's Cove Point
Berry's Cove
Lewis Point
Hand Bay
Cape Elan
Cape Crapaud
Fleur de Lys Har
St Pigeon I
Green Point
Little Lobster Har
Lobster Har
Coachmen's Harbour
Green Point
Point Rouge
Grappling Point
Cape Hat
Cape Corbin
Bois I
Cape St Martin
Red Pt
Ming's Bight
Pacquet
Pacquet Har
Cape Brulé
Cape Canis
Cape Cagnet
Confusion Bay
Cape St John
Reddits Pt
Middle Bit
South Bit
Reiped Pt
Brent Cove Hd
Long Pt
Mandul Hd
Gunning Pt
Bishop's Rock
Bluff Hd
Fishing Pt
Harbour Round
Mills Tickle
Tilt Cove (abandoned)
Tilt Cove
Scrape Pt
Round Harbour
Pigeon I
Lower Bill
Mouse Pt
Bobby Cove
Landlamas Hd
Nippers Islands
Green Hd
Flour Cask I
Burnt I
Rowland Pt
Young Hd
Green Bay I
Green Bay
Middle Arm
Hennessey Islands
Western Hd
Little Bay Hd
North Bill
South Bill
Gull Rocks
Middle Is
Crab I
Red Island
Rock
Burnt Hd
Northern Hd
Harbour I
Venison Pt
Wild Bight
Red I
Fox Neck
Little Bay Island
Hacks I
White Pt
Woody I
Fox Island
Copper I
Iron Pt
Beaver Cove Hd
Halls Bay Hd
Red Fishing Pt
Bob Pt
Shag Cliff
Suley Ann Rock
Western Hd
Beaumont
Giles I
Seal
Burnt Hd
Southern Head I
Southern Hd
Otter
Otter I
Little Bay
Darby Rock
Seal Cove
Fish Pt
Pigeon I
Frenchman's Hd
Jackson's Arm
Virgin Pt
Wild Cove Pt
Western Arm
Open Head
Sops Island
Sops Arm
Westport
Shale Pt
Granby I
Spear Pt
Spear Cove
Big Head
Cobbler Hd
Coney Head
Great Coney Arm
Little Coney Arm
Stumpy Point
Windy Point
Eastern Head
Western Head
Great Cat Arm
Little Cat Arm
Birdsey Head
Muddy Cove
Big Head
David Cove
Lewis
1400
Deer Cove
Eastern Point
Bois
Verte
Bois Verte
Slaughter House Cove
Muddy Cove
Big Head
Seal Cove
Fish Pt
Pigeon I
Wild Cove Pt
Western Arm
Westport
Shale Pt
Granby I
Spear Pt
Spear Cove
Sops Arm
Open Head
Sops Island
Frenchman's Hd
Jackson's Arm
Virgin Pt



BASE MAP COMPILED FROM PORTIONS OF NATIONAL TOPOGRAPHIC SURVEY MAPS 2E, 12A, 12B, 12G, 12H AND 12I

CONTOUR INTERVAL 100 FEET
Elevations in Feet above Mean Sea Level
North American Datum 1927
Transverse Mercator Projection

45'
30'
15'
7
5
5

GULF OF
Gulls Marsh
Martin Pt
Western Brook Pond
Sally's Cove
GROS MORNE
Green Point
Bakers Brook
Berry Hd
Lobster Cove
Rocky Harbour
Salmon Pt
Bonne Bay
Western Hd
Skinner Cove
Norris Point
Ferry
Lomond
East Arm
South Arm
Cape St Gregory
North Hd
Gregory
Beverley Hd
Saddle I
Green I
Hen I
Tweed I
Lowry Berth Cove
Shivery Pt
Harbour Pt
Crabb Pt
THE PILLARS
Pearl (Big) Island
Shag Rocks
Buck Hd
Stowbridge Hd
Pond Pt
North Arm
Guernsey Island
BAY OF ISLANDS
North Arm Pt
Barbours Hd
Eagle I
Northern Hd
Black Hd
Seal Hd
Long
South Hd
Trumpet Cove
White Point
Lake Siding
Pond
Adies
PC
CO
CL
CH
OG
OCV
2

Sops
Island
Sops
Arm
Spear Pt
Shale Pt
Granby
Westport
Pond
Dunn
Middle
Pond
Gull
Pond
Black
Lake
Sheffield
Lake
Adies
Pond
Lake
Siding
Pond
SANDY
LAKE
Three
Corner
Pond
Pond
Pond

LEGEND

INTERMONTANE TROUGH SEDIMENTS

CARBONIFEROUS

CD — DEER LAKE GROUP
- sandstone, conglomerate, siltstone, mudstone, minor limestone, oil shale and coal

CA — ANGUILLE GROUP
- siltstone, sandstone, conglomerate minor arkose, and limestone

SILURIAN

SP — SOPS ARM GROUP
- quartz-feldspar porphyry and acidic volcanics

SS
- shale, phyllite, sandstone, conglomerate, siltstone

CONTINENTAL MARGIN AND RIFT FACIES SEDIMENTS

EARLY ORDOVICIAN

OG — ST. GEORGES GROUP
- massive limestone, dolostone, plus interbedded shale and phyllite

CAMBRIAN

€H — HUMBER ARM GROUP KLIPPEN
- shale, phyllite, quartzite, sandstone, thinly bedded limestone

€L — LABRADOR GROUP
- slate, phyllite,

GRANITE COMPLEXES

DEVONIAN

7 — TOPSAIL GRANITE
- granite, quartz monzonite, minor granodiorite

6 — WILD LOVE POND AND GULL LAKE IGNEOUS SUITE
- granodiorite, diorite, feldspar porphyry

DEVONIAN TO SILURIAN

5 — CAPE BRULE PORPHYRY AND EQUIVALENTS
- quartz-feldspar porphyry, syenite, gabbro, minor ultramafic xenoliths

ORDOVICIAN

4 — BURLINGTON GRANODIORITE
- granodiorite, quartz-diorite, minor quartz monzonite

3 — HUNGRY MOUNTAIN COMPLEX
- foliated to massive granite, granodiorite, diorite, gabbro

ISLAND ARC COMPLEXES AND SUBAERIAL VOLCANICS

SILURIAN TO DEVONIAN

SDv — CAPE ST. JOHN, SPRINGDALE AND MIC MAC LAKE AND TOPSAIL GROUPS
- interbedded basic to acidic lavas and subaerial pyroclastic rocks, agglomerates, sandstone and conglomerate

LATE ORDOVICIAN TO EARLY SILURIAN

OSv — BUCHANS, ROBERTS ARM AND FLATWATER POND GROUPS
- basic to intermediate pillow lava, coarse volcanic breccia, agglomerates, acidic

BAY
OF
ISLANDS

CABOT FAULT

GRAND LAKE

MOUNTAIN

49°00'N

58°00'W

CG
Cb
Cb
Cb

conglomerate, siltstone

BURLINGTON GRANODIORITE
- granodiorite, quartz-diorite, minor quartz monzonite

HUNGRY MOUNTAIN COMPLEX
- foliated to massive granite, granodiorite, diorite, gabbro

CONTINENTAL MARGIN AND RIFT FACIES SEDIMENTS

EARLY ORDOVICIAN

ST. GEORGES GROUP
- massive limestone, dolostone, plus interbedded shale and phyllite

CAMBRIAN

HUMBER ARM GROUP KLIPPEN
- shale, phyllite, quartzite, sandstone, thinly bedded limestone

LABRADOR GROUP
- slate, phyllite, quartzite, thinly bedded limestone and dolostone

CAMBRIAN TO LATE PRECAMBRIAN

FLEUR DE LYS SUPERGROUP
- semipelitic, pelitic and psammitic schists, minor marble and quartzite

CONTINENTAL PLATFORM ROCKS

LATE PRECAMBRIAN

LONG RANGE COMPLEX
- granitic gneiss, metasedimentary gneiss, anorthosite, gabbro

ISLAND ARC COMPLEXES AND SUBAERIAL VOLCANICS

SILURIAN TO DEVONIAN

CAPE ST. JOHN, SPRINGDALE AND MIC MAC LAKE AND TOPSAIL GROUPS
- interbedded basic to acidic lavas and subaerial pyroclastic rocks, agglomerates, sandstone and conglomerate

LATE ORDOVICIAN TO EARLY SILURIAN

BUCHANS, ROBERTS ARM AND FLATWATER POND GROUPS
- basic to intermediate pillow lava, coarse volcanic breccia, agglomerates, acidic flows and tuffs, greywacke and argillite

EARLY TO MIDDLE ORDOVICIAN

VICTORIA LAKE GROUP
- slate, siltstone, argillite, sandstone, greywacke, minor volcanics

PACQUET HARBOUR, SNOOKS ARM, CATCHERS POND AND WESTERN ARM GROUPS
- basic to intermediate pillow lava and pyroclastic rocks, acidic pyroclastic rocks, agglomerates, breccia and minor sedimentary rocks

OPHIOLITE COMPLEXES

CAMBRIAN TO EARLY ORDOVICIAN

BAY OF ISLANDS KLIPPEN, BAIE VERTE AND BETTS COVE COMPLEXES
- basic pillow lava, pillow breccia, agglomerates and minor sedimentary rocks

- gabbro, diorite, quartz-diorite, sheeted diabase, minor ultramafic dykes and pods

- dunite, peridotite, pyroxenite and serpentinized equivalents

MAP SYMBOLS
Geological Boundary
Fault

SOURCES OF INFORMATION

Geology of the Baie Verte Penninsula, Map 82-2, 1982, Department of Mines & Energy, Government of Newfoundland and Labrador.

Geological Compilation of Newfoundland Central Volcanic Belt, Map accompanies manuscript 'Regional Geology of the Central Volcanic Belt of Newfoundland' in Geological Association of Canada Special Paper 22 in press. Map is available from Department of Mines and Energy, Government of Newfoundland and Labrador.

Geology, Sandy Lake Newfoundland, Preliminary Map 82-54, 1982, Department of Mines and Energy, Government of Newfoundland and Labrador.

Geology, Bay of Islands Newfoundland, Map 1335A, 1973, Geological Survey of Canada.

Geology, Stephenville Newfoundland, Map 1117A, 1962, Geological Survey of Canada.

Geology, Red Indian Lake (West Half) Newfoundland, Map 8-1957, 1957, Geological Survey of Canada.

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

MAP No. 2

BEDROCK GEOLOGY
HUMBER VALLEY AREA, NEWFOUNDLAND

Golder Associates

MW 4/3/83

Scale 1:250,000 Échelle

Miles 5 0 5 10 15 20 Miles

Kilometres 5 0 5 10 15 20 25 30 Kilomètres

45' 30' 15' 56°00'W 45' 30' 15' 49°00'N

30' 15' 58°00'W 45' 30' 15'

50°00'N

45'

STRAIT OF BELLE ISLE

HARE BAY

WHITE BAY

ATLANTIC OCEAN

BONNE BAY

BAY OF ISLANDS

NOTRE DAME BAY

FOGO

GANDER

BONAVISTA BAY

GRAND FALLS

STEPHENVILLE

TRINITY BAY

CONCEPTION BAY

ST. JOHN'S

GRAND BANK

PLACENTIA BAY

SCALE 0 20 40 60 80 100 KILOMETRES

Portland Creek

Portland Creek Pond

Inner Pond

Parson's Pond

Parsons Pond

Shallow Bay

Cow Head

Broom Pt

St Paul's Inlet

Gulls Marsh

Martin Pt

Western Brook Pond

Sally's Cove

Green Point

Bakers Brook

Lobster Cove

GULF OF ST LAWRENCE

GROS MORNE NATIONAL PARK

45' 30' 15' 57°00'W 45' 30' 15'

Portland Creek
Portland Creek Pond
Inner Pond
Parsons Pond
Parson's Pond
Sandy Bay
Shallow Bay
Shellidowns Point
St Pauls Inlet
Cook Pond
Great Cat Arm
Eastern Head
Western Head
Big Head
Cobbler Hd
Coney Head
Great Coney Arm
Frenchman's Hd
Virgin Pt
Open Head
Sops Island
Sops Arm
Granby I
Shale Pt
Spear Pt
Westport
Seal Cove
Fish Pt
Pigeon I
Wild Cove Pt
Lewis Point
Hurd Bay
Cape Eliz
Little Lobster Har
Green Point
Bare
WHITE BAY
ST BARBE SOUTH DISTRICT
WHITE BAY SOUTH DISTRICT
BAIE VERTE - WHITE BAY SOUTH DISTRICT

45' 30' 15' 56°00'W 45' 30'

50°00'N

WHITE BAY

BAIE VERTE - WHITE BAY DISTRICT

ISLANDS

Great Cat Arm

Eastern Head

Western Head

Big Head

Cobbler Hd

Corney Head

Frenchman's Hd

Virgin Pt

Open Head

Sops Island

Sops Arm

Spear Pt

Shale Pt

Granby I

Westport

Wild Cove Pt

Pigeon I

Fish Pt

Seal Cove

Big Head

Green Point

Little Labour Har

Cape Onion

Cape Crossed

Fleur de Lys Har

Pilleau I

Coachman's Harbour

Point Rouge

Cape Hat

Cape Corbin

Cape St Martin

Ming's Bight

Baie Verte

Cape Jacquet

Cape Brulé

Cape Cairn

Cape Cagnet

Long Pt

Brent Cove Hd

Hill Grandon Hd

Reddits Pt

Middle Bill

South Bill

Ragged Pt

Manful Hd

Gunning Pt

Bishop's Rock

Bluff Hd

Fishing Pt

Great Capin Cove

Beaver Cove Hd

Mine (abandoned)

Tilt Cove

Scraper Pt

Round Harbour

Pigeon I

Lower Bill

Indian Bay Pond

Bobbys Cove

Mouse Pt

Candlemas Hd

Nippers Islands

Green Hd

Flour Cask Hd

Young Hd

Green Bay I

Henry's Harbour

Western Hd

Hennessey Islands

Little Bay Hd

North Bill

South Bill

Gull Rocks

Middle Is

Crab I

Stag I

Dock

Woody I

White Pt

Northern Hd

Harbour I

Venison Pt

Red Island Rock

Burnt Hd

Red I

Wild Bay

Fox Neck

Little Bay Island

Fox Is

Beaver Cove Hd

Halls Bay Hd

Red Fishing Pt

Bob Pt

Iron Pt

Copper I

Hacks I

Western Hd

Beaumont Hd

Giles I

Seal

Otter

Burnt Hd

Wild

Southern Head I

Southern Hd

Otter

Pond

Arm

Green Bay

Kerling Pt

Sandy Cove

Middle Arm

Burlington

Flat Water Pond

Crow Pond

Ortoe

Shoal Cove

Big Pond

Pilleys Island Road

Pilleys Island Road

Eastern Pond

Diver Cove

Sawmill Cove

Sawmill Cove

Seal Cove

Cape Hat

Cape Corbin

Cape St John

Cape Cagnet

Long Pt

Brent Cove Hd

Hill Grandon Hd

Reddits Pt

Middle Bill

South Bill

Ragged Pt

Manful Hd

Gunning Pt

Bishop's Rock

Bluff Hd

Fishing Pt

Great Capin Cove

Beaver Cove Hd

Mine (abandoned)

Tilt Cove

Scraper Pt

Round Harbour

Pigeon I

Lower Bill

Indian Bay Pond

Bobbys Cove

Mouse Pt

Candlemas Hd

Nippers Islands

Green Hd

Flour Cask Hd

Young Hd

Green Bay I

Henry's Harbour

Western Hd

Hennessey Islands

Little Bay Hd

North Bill

South Bill

Gull Rocks

Middle Is

Crab I

Stag I

Dock

Woody I

White Pt

Northern Hd

Harbour I

Venison Pt

Red Island Rock

Burnt Hd

Red I

Wild Bay

Fox Neck

Little Bay Island

Fox Is

Beaver Cove Hd

Halls Bay Hd

Red Fishing Pt

Bob Pt

Iron Pt

Copper I

Hacks I

Western Hd

Beaumont Hd

Giles I

Seal

Otter

Burnt Hd

Wild

Southern Head I

Southern Hd

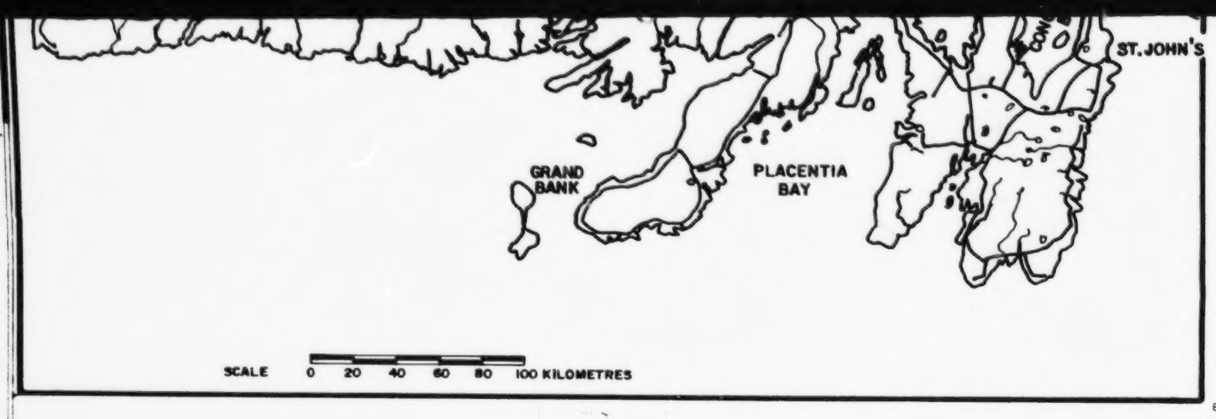
WF XF

WE XE

N O T

45

DISTRICT



BASE MAP COMPILED FROM PORTIONS OF NATIONAL TOPOGRAPHIC SURVEY MAPS 2E, 12A, 12B, 12G, 12H AND 12I

CONTOUR INTERVAL 100 FEET
Elevations in Feet above Mean Sea Level
North American Datum 1927
Transverse Mercator Projection

45

30

15

GULF OF ST. LAWRENCE

BAY OF ISLANDS

HUMBER – ST. BARBE DISTRICT

GROS MORNE NATIONAL PARK

Gulls Marsh
Martin Pt
Western Brook Pond
Sally's Cove
Green Point
Bakers Brook
Berry Hd
Lobster Cove
Rocky Harbour
Salmon Pt
Bonne Bay
Western Hd
Skinner Cove
Norris Point
Woody Harbour
East Arm
Lomond
Trout River
Big Cove Hd
Cape St George
Chimney Cove
MT. ST. GREGORY
North Hd
Beverley Hd
Gregory I
Saddle I
Green I
Hen I
Tweed I
Shivery Pt
Harbour Pt
Crabbe Pt
THE PILLARS
Pearl (Big) Island
Shag Rocks
Buck Hd
Stowbridge Hd
NORTH ARM MTN
North Arm
Pond Pt
Barbours Hd
Guernsey Island
North Arm Pt
Eagle I
Northern Hd
OLD MAN HEAD
South Hd
Trumpet
Black
Seal
Adies Dam
Pond
Reidville
Dover Lake
Nicholaville
Lake Siding
Pensticks
Dam
Dover
Dam
Dam
Dam

HUMBER – ST. BARBE DISTRICT

HUMBER VALLEY DISTRICT

GREEN BAY DISTRICT

WHITE BAY SOUTH DISTRICT

HUMBER EAST DISTRICT

GREEN BAY DISTRICT
GRAND FALLS DISTRICT

Westport

Sops Island

Sops Arm

Spear Pt

Granby Cove

Shale Pt

Nutgrove's Cove

Humphrey Cove

Schooner Cove

Harrys Arm

Big Beaches

Black Lake

Gull Pond

Sheffield Lake

Barren Pond

Island Pond

Three Corner Pond

Adies Pond

Alder Pond

Kitty's Brook

Reidville Junction

Deer Lake

Nicholsville

Lake Siding

Penstock

Sir Richard Squires Mem. Park

Trans-Canada Highway

Humber River

Main River

Crow Brook

Indian River

Baie Verte Prov. Park

Harding Prov. Park

Southwest Arm

Sandy Lake

Canadian National Railways

Narrow Gauge

Dam

Power Line

Pond

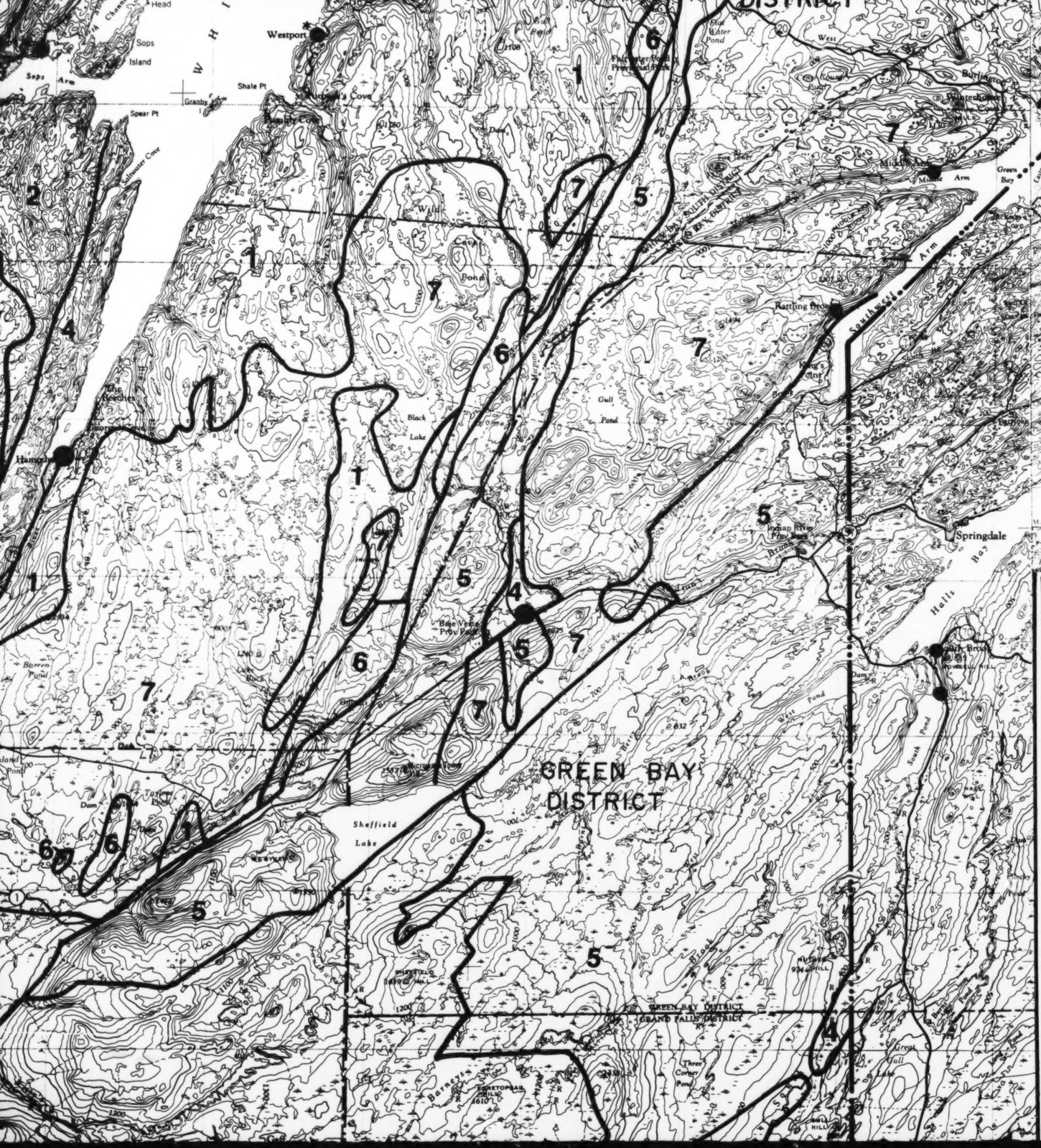
Lake

Brook

River

Hill

Mtn.


GREEN BAY DISTRICT
GREEN BAY DISTRICT
GRAND FALLS DISTRICT
Westport
Sops Island
Sops Arm
Shale Pt
Spear Pt
Granby I
Hampden
The Beeches
Black Lake
Gull Pond
Kettling Brook
Springdale
Indian River
Middle Arm
Green Bay
Southwest Arm
Sheffield Lake
Barnes Pond
Barren Pond
Island Pond
Three Corner Pond
Great Gull Lake
Halls Bay
Burnt Hill
Stickle Hill
Mount Peyton
Mount Misery
Bay Verte Provincial Park
Trans-Canada Highway
Provincial Highway
Secondary Road
Railway
Power Line
Lake
Pond
Dam
Bridge
Ferry
Lighthouse
Church
Cemetery
Campground
Picnic Area
Boat Launch
Airport
Mine
Quarry
Peat Bog
Marsh
Swamp
Contour
Spot Elevation
Benchmark
Triangulation Station
Provincial Boundary
Municipal Boundary
Reserve
Indian Reserve
Forest Fire Protection Area
Forest Access Road
Forest Service Station
Forest Service Tower
Forest Service Cabin
Forest Service Campground
Forest Service Picnic Area
Forest Service Boat Launch
Forest Service Airport
Forest Service Mine
Forest Service Quarry
Forest Service Peat Bog
Forest Service Marsh
Forest Service Swamp
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Forest Service

BAY OF ISLANDS DISTRICT

WEST DISTRICT

HUMBER EAST DISTRICT

ST GEORGES DISTRICT

BAY OF ISLANDS

OF

ISLANDS

NORTH ARM MTN

OLD MAN HEAD

VIRGIN MTN

CORNER BROOK

GRAND LAKE

GRAND LAKE MOUNTAINS

Pearl (Big) Island

Woods Island

Puffin Islands

Wood's Island

Guernsey Island

Shag Rocks

Deer Lake

Pynns Brook

Reidville

Nicholsville

Lake Sidings

Steady Brook

Corner Brook

Georgetown

Humber Arm

Humber Arm Wharves

Mount Moriah

Halfway Point

Frenchman's Cove

Bear Cove

Fox Point

Giles Pt

Shivers Pt

Harbour Pt

Crabbe Pt

Black Hd

Stowbridge Hd

Pond Pt

Barbours Hd

North Arm Pt

Eagle I

Northern Hd

Seal Hd

Woman Pt

Long Pt

Middle Arm Pt

Cox's Pt

Peter Pt

McIver's Pt

Frenchman's Hd

Shoal Pt

Balance Pt

Fleming Pt

Tortoise Point

Devil Hd

Little Port Hd

Trumpet Cove

White Point

Seal I

Green I

Hen I

Sloop I

Beverley Hd

Gregory I

Lower Berth Cove

Bear Hd

Fish Head

Rope Cove

Shag Island

Long Ledge

Broad Cove Pt

Mine Cove

Pen Islands

Coal River Head

Serpentine Lake

Little Grand Lake

Grand Lake

Northern Harbour

Wharf

Penstock

Humber Dam

Glide

Dam

Boom piers

Island Pond Dam

Steady Brook Lake

Lake Sidings

Reidville

Nicholsville

Deer Lake

Pynns Brook

South Brook

Corner Brook

Georgetown

Humber Arm

Humber Arm Wharves

Mount Moriah

Halfway Point

Frenchman's Cove

Bear Cove

Fox Point

Giles Pt

Shivers Pt

Harbour Pt

Crabbe Pt

Black Hd

Stowbridge Hd

Pond Pt

Barbours Hd

North Arm Pt

Eagle I

Northern Hd

Seal Hd

Woman Pt

Long Pt

Middle Arm Pt

Cox's Pt

Peter Pt

McIver's Pt

Frenchman's Hd

Shoal Pt

Balance Pt

Fleming Pt

Tortoise Point

Devil Hd

Little Port Hd

Trumpet Cove

White Point

Seal I

Green I

Hen I

Sloop I

Beverley Hd

Gregory I

Lower Berth Cove

Bear Hd

Fish Head

Rope Cove

Shag Island

Long Ledge

Broad Cove Pt

Mine Cove

Pen Islands

Coal River Head

Serpentine Lake

Little Grand Lake

Grand Lake

Northern Harbour

Wharf

Penstock

Humber Dam

Glide

Dam

Boom piers

Island Pond Dam

Steady Brook Lake

49°00'N

48°45'

30'

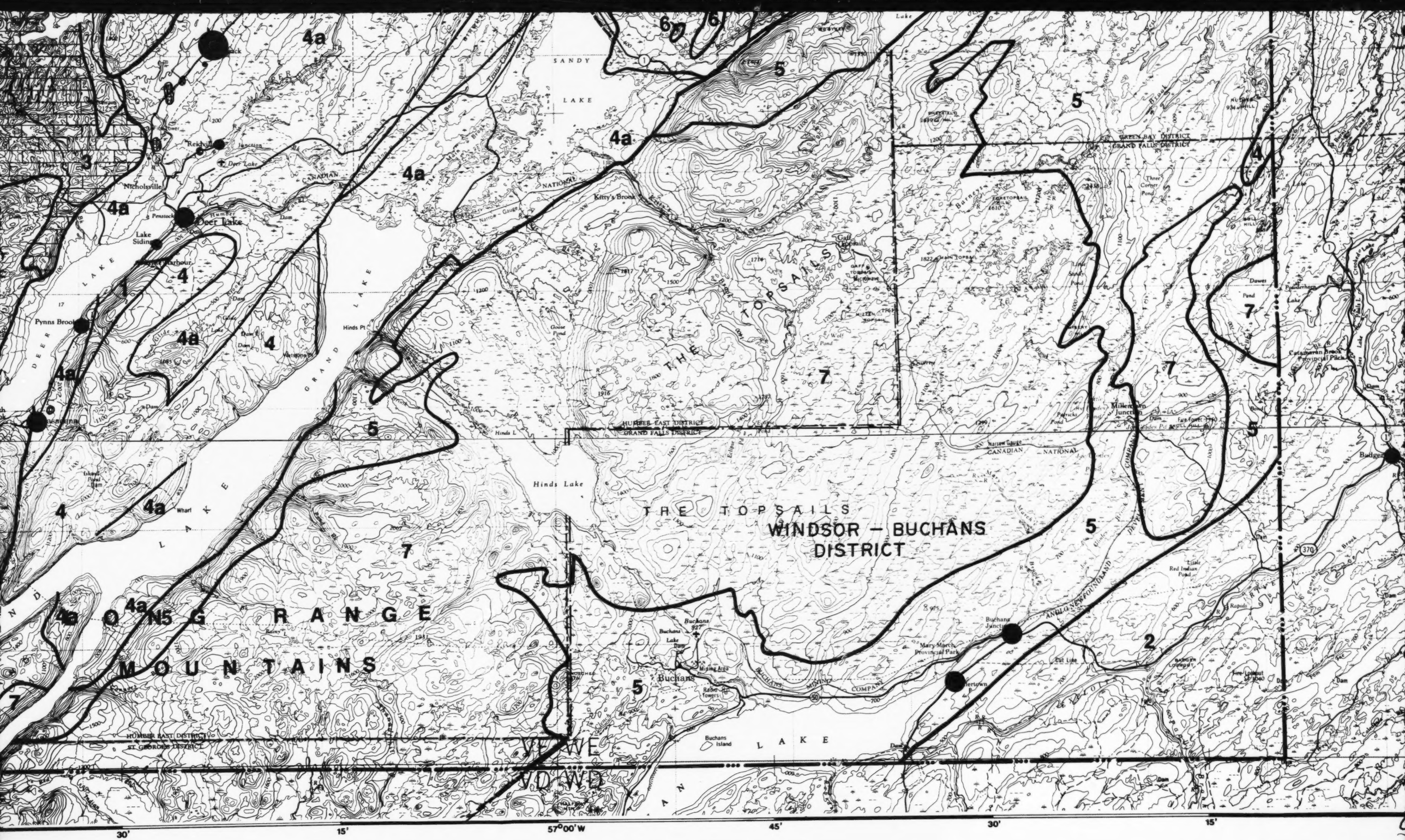
15'

58°00'W

45'

30'

15'


SANDY LAKE
THE TOPSAILS
WINDSOR – BUCHANS DISTRICT
GREEN BAY DISTRICT
GRAND FALLS DISTRICT
HUMBER EAST DISTRICT
GRAND FALLS DISTRICT
HUMBER EAST DISTRICT
ST GEORGES DISTRICT
MOUNTAINS
LAKE
Deer Lake
Nicholsville
Reidville
Junction
Lake Sidings
Pynns Brook
Hinds Pt
Hinds Lake
Kitty's Brook
Goose Pond
Wolf Pond
Buchans
Buchans Island
Buchans Junction
Millertown Junction
Mary March Provincial Park
Crocker Provincial Park
Catamaran Brook Provincial Park
Badger
Bishops Falls
Grand Falls
Windsor
Topsail
Barneys
Three Corner Pond
Dawes Pond
Patricks Pond
Crooked Lake
Great Gull Lake
Little Gull Lake
Fourchette
Narrow Gauge
CANADIAN NATIONAL
ANGLO NEWFOUNDLAND
BUCHANS MINING COMPANY
Mining Area
Radio Towers
Lookout Tower
Fire Lookout Tower
Dam
Rapids
Wharf
Ferry
Cut Line
Little Red Indian Road
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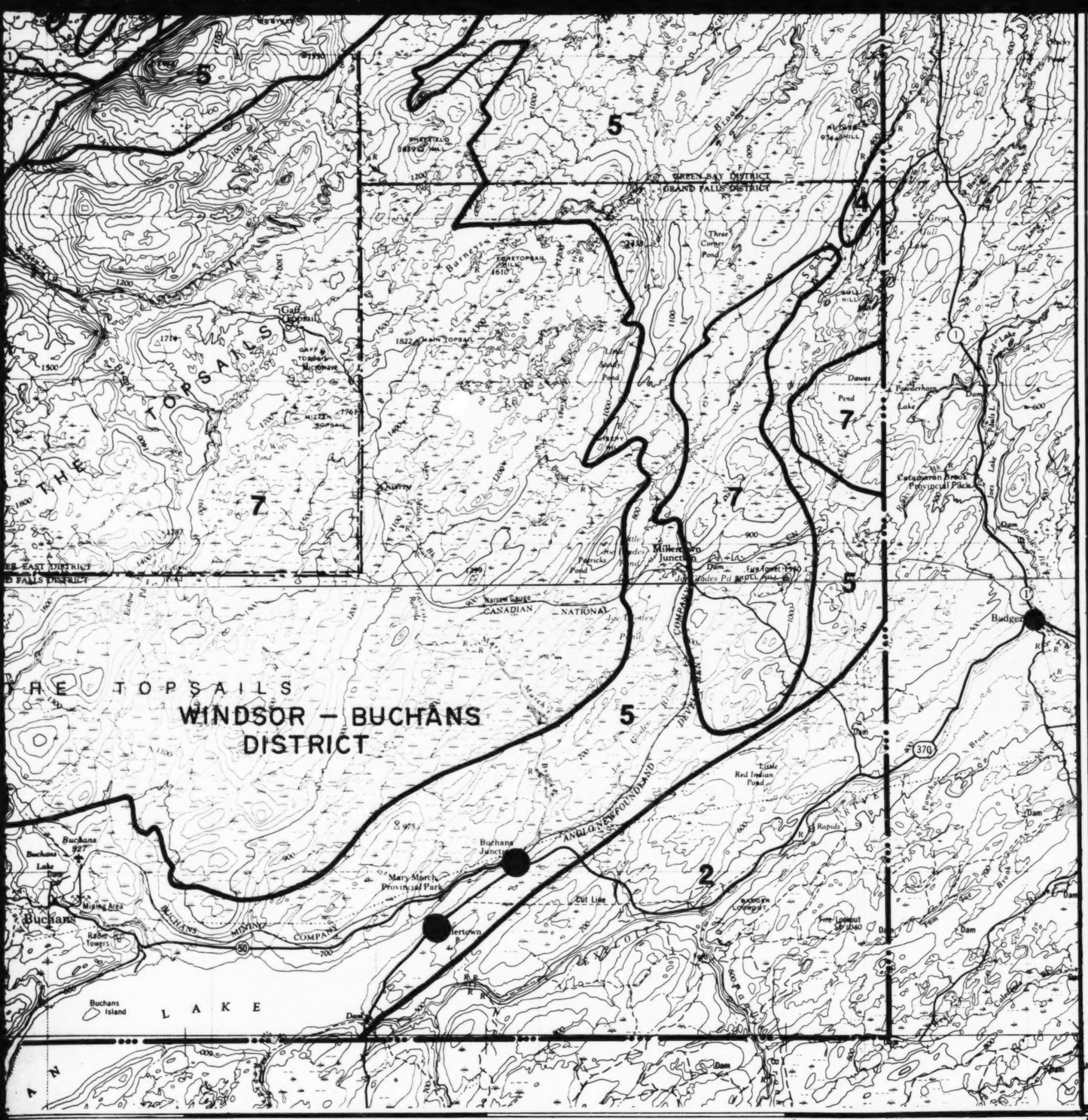
30'
15'



SHALE, SANDSTONE, LIMESTONE, DOLOSTONE, PHYLLITE	32)			368)		
UNIT 3 HIGH YIELD ST. GEORGES GROUP LIMESTONE, DOLOSTONE, SHALE, PHYLLITE	13.6–159 (3–35)	77.3 (17)	45 (10)	31.7–37.8 (104–124)	34.4 (113)	34.4 (113)
UNIT 4 and 4a* LOW TO MODERATE YIELD ANGUILLE AND DEER LAKE GROUPS SANDSTONE, CONGLOMERATE, SILTSTONE, MUDSTONE	0.45–91 (0.1–20)	21.8 (4.8)	17.3 (3.8)	11.6–181.4 (38–595)	53.6 (176)	45.7 (150)
UNIT 5 MODERATE YIELD VOLCANIC GROUPS VOLCANIC FLOWS, TUFFS, MINOR SEDIMENTS	1.1–455 (0.25–100)	58.2 (12.8)	22.7 (5)	13.7–107.6 (45–353)	41.8 (137)	33.5 (110)
UNIT 6 LOW YIELD OPHIOLITE COMPLEXES ULTRAMAFIC, GABBRO, SHEETED DIABASE	2.3–18.2' (0.5–4)	9.5 (2.1)	9.1 (2)	22.3–93 (73–305)	53.9 (177)	61 (200)
UNIT 7 LOW YIELD GRANITE AND LONG RANGE COMPLEXES GRANITE, GRANITE GNEISS, DIORITE, PORPHYRY		20.5 (4.5)	9.1 (2)		42.1 (138)	

NOTE: * UNIT 4a – DEER LAKE GROUP, CONTAINS OCCURRENCES OF SODIUM CHLORIDE AND CALCIUM SULPHATE GROUNDWATER, TRACES OF NATURAL GAS AND HYDROGEN SULPHIDE ODOUR.

⊕ IDENTIFIED SALINE GROUNDWATER OCCURRENCES.

† FOR DETAILED DATA USED IN TABLE COMPILATION SEE ACCOMPANYING REPORT.

NUMBER OF WELLS LISTED PER COMMUNITY;

● 1–2, ● 3–5, ● 6–10, ● 11–20 WELLS

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

MAP No. 3

BEDROCK HYDROSTRATIGRAPHIC UNITS

HUMBER VALLEY AREA, NEWFOUNDLAND

Golder Associates

MHW 4/3/83

Scale 1:250,000 Échelle

Miles 5 0 5 10 15 20 Miles

Kilometres 5 0 5 10 15 20 25 30 Kilometres

49°00'N

15'

45'